Telephony.

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Installment-Buying as Applied by One Telephone Manager

A real, honest-to-goodness insight into the installment-buying practice was obtained from the letter written by one of Telephony's subscribers—a telephone exchange owner-manager—that appeared on page 31 of the November 30 issue.

We have all heard plenty of theoretical discussion about installment-buying, but that letter gave the cold facts of the practical experience of a telephone man who put into effect the partial payment plan with results so successful as to be actually astonishing.

* * * *

For a number of years he bought on the installment plan everything from real estate to bank stock. Furniture, radio and automobiles, of course, were easy to buy by instalments, but he didn't stop there. He bought his house on the installment plan, all its furnishings, and even the telephone property, serving 500 subscribers—and today he owns all these goods, chattels and realty entirely clear of debt.

It is really a notable achievement, testifying to the possibilities of shrewdly-managed installment-buying, and also to a faithful persistence on the part of the man in question.

* * * *

In our correspondent's letter is an idea that telephone manufacturers and supply dealers might adopt with profit. This manager points out that when he decided to improve his telephone plant, lay more cable, put in a common battery switchboard to replace magneto, buy a ringing machine and a new telephone booth, he found that it could not be done on the installment plan.

Having financed a score of other purchases by that plan so successfully, he was disappointed. He says he was offered the usual 30 or 60 days' credit, but the installment plan could not apply to expenditures for the improvement of his property. That's what made him "wonder why."

* * * *

Manufacturers and supply dealers undoubtedly know their business, but this telephone man's query suggests that some plan might be worked out to meet such cases, and with advantage to all concerned.

A financing company that would supply funds to operators who desire to purchase equipment might find a desirable field of activity if it arranged to carry the accounts of reliable concerns which preferred to buy on the installment plan.

Credit corporations have been organized to handle the paper of buyers in several fields, and are operating with marked success.

This is notably true in the automobile business, and the larger car manufacturers have come to recognize such financing concerns as a valuable help to their industry. In fact, it is said that were it not for such credit companies the distribution of automobiles would be lagging far behind the present record.

Ordinarily, a company so fortunately situated as our subscriber-correspondent should have no difficulty in making banking arrangements in order to purchase plant material. Probably he could do so easily enough, as he is a bank stockholder; but, having made all his other purchases on the installment plan, he desires to buy his switchboard, cable, ringing machine and booth the same way. And he "wonders why" he can't!

Maybe some of our manufacturing friends can devise some means to fit such a case, for this manager is in the market to place several orders.

Mr. Hoover's Views.

Surprisingly little about public utilities is found in President Hoover's message to the new Congress. Usually the executive report to a new Congress, in recent years, has made a number of recommendations regarding the relations of public service companies to their patrons and the government. President Hoover says nothing about the old issue of government ownership of utilities, nor does he utter any of the equally old platitudes about "reasonable rates" and "efficient service."

The President does recommend the creation of a new power commission, to handle interstate matters, but he is not in favor of any interference with the state commissions in their regulation of intrastate service which constitutes 90 per cent of all power generated and distributed.

* * * *

President Hoover also urges the reorganization of the radio commission into a permanent body. His views on this sub-

ject and on the proposed power commission indicate that the President will not be in favor of the Couzens' communications commission bill, which aims to place the telephone, telegraph, cable, radio, and even electrical power lines under the jurisdiction of one federal commission.

While Mr. Hoover has expressed no opinion publicly on the communications commission plan, the fact that he favors a separate commission for power regulation and another for radio would seem to prove that he would not believe good results could follow the assembling of so many enterprises under one regulatory authority.

Naturally, the President is not manifesting opposition to Senator Couzens' pet hobby so far in advance of its enactment into law. That would be poor politics. The executive ideas as to the first two commissions mentioned, however, indicate a belief in the theory of one commission to one business.

* * * *

The last paragraph of the President's message expresses the guiding principles of true American government with admirable exactness.

"The test of the rightfulness of our decisions must be whether we have sustained and advanced the ideals of the American people," said he; "self-government in its foundations of local government; justice whether to the individual or to the group; ordered liberty; freedom from domination; open opportunity and equality of opportunity; the initiative and individuality of our people; prosperity and the lessening of poverty; freedom of public opinion; education; advancement of knowledge; the growth of religious spirit; the tolerance of all faiths; the foundations of the home, and the advancement of peace."

COMING CONVENTIONS.

South Dakota Telephone Association, Watertown, Hotel Lincoln, January 14, 15 and 16.

Minnesota Telephone Association, Minneapolis, Radisson Hotel, January 28, 29 and 30.

Oklahoma Utilities Association, Tulsa, Mayo Hotel, March 11, 12 and 13.

Nebraska Telephone Association, Omaha, Hotel Paxton, February 11, 12 and 13.

Indiana Telephone Association, Indianapolis, Claypool Hotel, May 6, 7 and 8.

Pennsylvania State Telephone & Traffic Association, Penn-Harris Hotel, Harrisburg, May 13, 14 and 15.

Up-State Telephone Association of New York, Rochester, May 21, 22 and 23.

Increasing the Net Telephone Profits

Industrial Development of the Nation Has Closely Followed That of the Electric Light and Telephone—Various Manners in Which Increased Earnings May be Effected—Address Given at Annual Convention of National Association

By John H. Agee,

General Manager, Lincoln Telephone & Telegraph Co., Lincoln, Neb.

Three years ago we celebrated throughout the nation the 50th birthday of the invention of the first telephone, honoring at that time the memory of the man who had given this wonderful invention to the world—Alexander Graham Bell.

This week of our convention the electric light and power industry is properly observing the 50th birthday of that equally wonderful invention and discovery, the incandescent lamp, and honoring its renowned inventor—Thomas A. Edison.

It is altogether appropriate, in my opinion, that we of the telephone industry pay our respect and homage to that master mind of the electrical world. Without electricity the modern telephone would be a mere toy; without the incandescent lamp our modern switchboards would lose much of their splendid efficiency.

These two American geniuses—giants in their respective fields—have probably contributed more to human welfare and happiness than any other two men since the time of Abraham Lincoln.

Through the development and use of these marvelous electrical devices and inventions, America has become the foremost nation of the world in wealth and prosperity.

The phonograph, an invention of Edison, has brought to our homes the music of the great artists—the finest in entertainment and culture. Within the past 25 years the automobile industry has grown from an infant enterprise to one of the gigantic industries of the world, representing a total investment of more than 25 billions of dollars. Without the storage battery, discovered by Mr. Edison, this great achievement would hardly have been possible.

All these things have so changed American life that today in home, factory and school—in city, hamlet and countryside—the entire plan and program of living has risen to a plane never hitherto known among the peoples of the earth.

With greatest and most sincere appreciation, then, we acknowledge our debt of incalculable gratitude to that outstanding American citizen and inventor—Thomas A. Edison. May he enjoy many more years, each filled to overflowing with health and happiness, inspired by the adoration and appreciation of a grateful American people.

And then, without in the slightest dimming the glory of this great man and his achievements, and with due modesty, as becomes those who would walk humbly and uprightly, we turn our eyes a moment (before addressing ourselves to the assigned subject) to the achievements of our own industry.

So closely has the industrial development of the nation followed that of the electric light and telephone, it is only fair to state that the tremendous growth of American business experienced in the past quarter-century could never have been attained without both the development of electric light and power and the universal use of the telephone.

Bringing the electric light and electrical apparatus into the home has been no more wonderful than placing in that home the means by which the occupants can instantly communicate by spoken word with the entire outside world. Business would stagnate, social life would disintegrate, church and school would decline, and human life and health suffer immeasurably were our telephone exchanges and long wire facilities discontinued but for a few days.

The telephone has made possible the transaction of business in daily volumes of billions of dollars as simply as "over the counter" transactions, between the great commercial centers of the world. It has brought comfort and cheer to the home. It has joined neighbor to neighbor in the rural districts and enabled the farmers living miles from town to receive the daily markets, hear the daily news, and more recently, to listen to the world's best entertainment broadcast now via telephone wire.

Considering these wonderful benefits which mankind is today receiving through the use of the telephone, it may seem like descending from the sublime to the ridiculous to now discuss briefly the rather sor-

did topic of "How to Increase the Net Profits."

And yet, this universal and necessary communication service cannot be furnished and maintained unless you and I as owners, managers and operators of many links in the great network of telephone wires now covering the United States and serving its people, continue to do our share and do it adequately and efficiently. To continue this service, capital must be satisfied by a proper return and net profits are absolutely necessary.

I am here reminded of the colored man who was heard talking to his stubborn mule.

"What's that you call your mule," he was asked.

"I calls him Corporation," answered the old darky.

"How did you come to give him such a name?"

"Frum studin' de animal and readin' de papahs. Dat mule gits mo' abuse and blame dan anything else in de city, and goes right ahead havin' his own way jes de same."

Too many people still hold the idea of the colored man, that corporations have their own way regardless of the public, but in the telephone field we have in most cases been able to cooperate with our patrons and in recent years criticism and abuse have largely disappeared.

In the earlier days serious mistakes in offering our service on too broad a basis at too low a cost were made, and the necessity for correcting these mistakes has sometimes met with rather determined opposition. A better understanding of our problems and our ideals, through the many constructive methods of establishing and maintaining good public relations, has brought about a much more stisfactory situation.

The net profits of the Independent telephone industry as a whole in 1928 were too low to provide a fair return on investment, and considering the problem from all angles, the profits were really inadequate for operation. I refer now to the fact that the Interstate Commerce Commission reports of class A companies show an average net return for all companies on book value only of 6.7 per cent.

On a fair value basis, the return would undoubtedly be much lower, and if the depreciation and maintenance rate, which, combined, was only 7.9 per cent for last year, were placed at 9 per cent or 10 per cent, which long experience will justify, the resulting net return would have been much too low.

Surely the public which has received the marvelous benefits of this necessary industry and which must depend upon it for greater usefulness in the expanding business, social, civic and educational needs of this country, will readily agree that our business be protected by fair profits and adequate reserves.

In the early years of the Independent telephone business our attention was given more largely to plant and engineering problems. Obviously, the physical property had to be first constructed. Attachment of business in many cases came without effort on our part. In the larger centers where competition existed, this did not always follow and there the first real commercial efforts were made. Generally, greater attention and emphasis were placed upon construction problems than upon revenue producing.

"No Service Can Be Permanently Sold on a Profitable Basis," Says Mr. Agee, "Which Does Not Give to the Customer the Fullest Value for the Dollar He Pays."

The need for proper accounting was likewise recognized rather early in the business, one reason being that our bankers insisted upon it; but the development of commercial departments and the application of intelligent effort to produce more business have received greater encouragement the past ten years than in any previous period. And within the past five years most companies have engaged in comprehensive commercial programs, designed to produce needed revenue not only from exchange and toll development but from other sources termed in the manufacturing world, by-products.

The commercial department is rapidly coming into its own. After having occupied the kitchen for so many years, like Cinderella, it has at last been discovered and now, with the rest of the family, occupies the parlor.

For years commercial activities were rather looked down upon by the plant and engineering departments. I have heard trained engineers and construction men speak lightly of commercial activities. One very competent engineer made the remark to me within the last year that anybody could be a commercial man.

What we have come to realize is this: That while engineering, plant and accounting problems are of the utmost importance they are nevertheless inside matters, to be considered and determined by management. Commercial problems, on the other hand, have to do with the public and for successful results must be sold to the public. If the public is to pay us more money, it properly wants to know the whys and wherefores. The job of the commercial department, therefore, is a most important one, and its employes should be experienced and trained telephone men.

Basically, our revenue must come: First, from exchange rentals; second, from long distance or toll business.

These two sources are so well known to every telephone man that we shall take no time here to discuss them other than to say that obtaining proper rates is fundamental; and before great effort is placed upon increasing revenues from other sources, rates should be adjusted to recognized standard levels.

Campaigns at regular intervals, either in spring or fall, for securing additional stations, both main and extension, selling P. B. X. installations, and encouraging greater and extended use of long distance service, are conducted by practically all companies today, and I shall give them no attention. Excellent results inevitably follow the well-directed campaign for these purposes. They are almost certain producers of increased exchange and toll revenue.

The beneficial results of commercial surveys analyzing the needs of larger business institutions for a more complete and satisfactory service; the sale of handsets and colored sets; the sale of cordless P. B. X. equipment, and other like services, are well known to every telephone manager.

I want to emphasize, however, the possibilities of increased earnings through the sale of so-called supplemental services. These services can be offered to the public in most instances on the same basis as other commercial houses sell their products—that is, without direct public regulation. They are classified as miscellaneous operating revenues and offer a most fertile and under-developed field for increasing the net profits. In our company, miscellaneous revenues are less than 5 per cent of our exchange revenue—but in dollars run close to $100,000 per year, and without this revenue we would have no surplus at the end of the year. Its importance is, therefore, readily seen.

The major sources of miscellaneous revenue are in the following activities:

1. Directory advertising.
2. Renting of public address equipment.
3. Selling remote control radio programs.

4. Furnishing so-called "program service," or leasing facilities for this purpose.

5. Secretarial service.

6. Supplying dictation or stenographic service.

Directory advertising needs no introduction to you. The results are immediate and can be constantly improved. In our own company the first real effort to increase directory advertising was made in 1921. In one year revenues from this source increased from $14,492 to $29,106, over 100 per cent increase; and each succeeding year this revenue has grown, until in 1929 it will exceed $50,000.

Three years ago we purchased a No. 1, 2 and 3, Western Electric public address system. Sales of the services of these units during 1928 and 1929 have been very satisfactory; the gross this year will exceed the initial cost of the equipment. It falls far short of being all net as the expense of installation, operation and depreciation of delicate equipment is very high, but it nevertheless has apparent possibilities and the demand for its use is constantly increasing.

The sale of remote-controlled radio programs is a source of revenue almost unknown five years ago. In the territory covered by our company it has proved a good field for commercial cultivation.

With the allocation of wave lengths and restriction of use of the air to definite periods, many of the smaller and weaker broadcasting stations were discontinued, and to this extent this avenue of business has been cut off; but there are still many occasions when the sponsors of a special program or a convention committee can be sold on the idea of broadcasting the program or feature of a convention. The business is a profitable one.

Program service is another recent source of additional revenue. Whether you desire to engage in this activity is a question which calls for serious deliberation.

Clearly, no service should at any time be offered to the public which might in any way interfere with or disturb telephone service. In Lincoln, program service is offered by a company organized and maintained entirely separate from the telephone company. We lease wires and other facilities to the program service company on a profitable basis to us. In our contract we retain absolute control over facilities and without advance notice can repossess wires for telephone use and can refuse to furnish facilities at our pleasure.

Wire rentals for program service produce a direct revenue for the telephone company of about $800 per month. In addition to this amount, we charge for installations, removals and service, resulting in an income from labor which actually amounts to a reduction in payroll costs of men in the service department working on a monthly basis and doing program service work during otherwise slack or idle periods.

The profits from this source are still, in my opinion, uncertain and speculative. While we believe it should be encouraged, we advise caution in the matter of providing facilities other than those generally present in all well-maintained telephone plants. Income received from idle facilities, existing for purposes of caring for future growth, is certainly a welcome addition to net profits.

We come, lastly, to the two new and unexplored fields of commercial activity which in my opinion afford an unusually profitable field for additional revenue production—secretarial and stenographic or dictation service. The latter of these is an idea growing out of the former.

Secretarial service is merely arranging equipment so that our operators can answer calls for unattended telephones—that is, in offices where the services of an office girl or stenographer are apparently not needed. The professional man—lawyer, doctor or dentist—the real estate dealer or insurance broker, with little or no office help, is asking us to handle his office telephone during his absence. This new service was not originally initiated or proposed by us. It came in requests from this class of business.

We began experiments last year and as might be expected ran into some circuit and switching problems not quite so easy to solve in automatic exchanges, and particularly in multi-office areas. Our engineers have now designed circuits and setups which we believe fully provide the need, and soliciting of secretarial service is on our commercial program for the immediate future.

One cause for delay is from the legal side. Care must be taken in preparing a contract under which the subscribers will relieve the company from liability for failure to convey or interpret information correctly.

I might say that in the few cases in which we have been furnishing what might be termed the unperfected service the past twelve months, the patrons have been highly pleased with it.

Secretarial service, as such, contemplates that the operator shall receive from the office served, information from the subscriber as to his contemplated absence from the office, and the information which she, in turn, shall give to anyone calling his telephone number. Upon his return to his office, the subscriber signals the operator and receives from her any information regarding calls which have come in during his absence.

While this service will receive its largest demand in cities, it is valuable and can be sold in towns of small size. Indeed, we have urgent calls for this service in several of our county-seat towns at this time. The question of the proper charge is still undetermined but certainly the charge should not be less than the monthly charge for an additional main line telephone.

In cities the service can also be sold, we believe, to homes where the lady of the house desires to receive any telephone calls that may come in during her attendance at the bridge club.

We understand that this service is now being offered in a limited way by some of the associated Bell companies. Undoubtedly valuable information can be obtained as to the profitableness of the service within the next year. Letter-writing or stenographic service is likewise being experimented with by some of the associated companies. In conferring with some of our patrons who are desiring secretarial service, we have met an enthusiastic response to inquiries regarding the dictation or stenographic service.

It seems rather a departure from telephone business to engage in that of public letter-writing, but it falls so closely in line with secretarial service that, after due consideration, I believe you will agree that in the larger cities it can be profitably undertaken in order to complete an office service to the professional man who employs no stenographer but nevertheless would like on occasions to have his correspondence neatly and properly typed.

The plan can be offered about as follows:

The stationery of the customer is kept in the desk of the stenographer at the telephone office who is undertaking this work. The customer calls the telephone operator and asks for a public stenographer. The stenographer's telephone is equipped with a headset. She opens her notebook, takes down the letters dictated over the tele-

An Appreciation from a Successful Telephone Man.

Louis Pitcher is president and general manager of the Dixon Home Telephone Co. of Dixon, Ill., operating nearly 4,000 stations. He is also president of the Illinois Telephone Association, having recently been reelected for a second term.

Commenting on a recent article that appeared in TELEPHONY, Mr. Pitcher, in a letter to Secretary A. J. Parsons of the Illinois association, said:

"The telephone industry can congratulate itself that it has such a splendid, wide-awake journal disseminating worth-while ideas to the telephone property operators. To it much of the credit is due for the present high grade of telephone service throughout the country."

Coming from a successful telephone owner like Louis Pitcher, who is a man of few words, this commendation of TELEPHONY is more than ordinarily appreciated.

phone, writes them, addresses the envelopes, and they are delivered in a few minutes at the patron's office or mailed directly, as he may desire. The charge is made on a per letter basis.

Whether this service will offer the return indicated by the secretarial service may be properly questioned. Only by soliciting the business and trying it out on a temporary basis can the question be answered. It is suggested in this paper only to demonstrate that there are various ways by which the revenues of a telephone company may be increased other than by asking for additional exchange rates. Many of the methods suggested in this paper are not available to the small companies, and to that extent I regret their emphasis.

While the foregoing suggestions have been directed toward increasing revenue from miscellaneous sources, the net profits will disappear if the management fails to look after leaks or neglects to stop extravagant or wasteful practices. The modern idea tends toward overlooking expense on the theory that you must first give, if you are to receive.

Mr. Brown of the United Companies at Abilene, Kans., has made a splendid success practicing this theory. He used to caution us not to put a penny in front of our eyes and hide a dollar, and I believe it is easy to do this. Economy programs are often more harmful than helpful, but nevertheless a proper balance must be maintained between outgo and income.

In our endeavor to build up good will and encourage harmonious public relations, I think we oftentimes have spent more money than necessary and have failed to properly analyze our operating expenses. Public contributions may become extravagant. We believe in these, but they must be watched.

In recent years we have found newspaper publicity to be of great value in telling our story to the public; but unless this item is carefully watched we may easily succumb to the persuasions of the advertising solicitor for more copy. It is a very easy matter, in my opinion, to become extravagant in general publicity and particularly in newspaper advertising, the value of which we all recognize, but which in our line can easily be overdone.

Those of you who publish a house organ or employes' magazine will find that the tendency is to increase the size and quality of such publication and always at a large increase in expense.

If your company covers a territory of any size and you have undertaken to supply different communities on different occasions with public speakers, you will be surprised to find how much the actual cost of travel, to say nothing of time used, is required to meet these engagements. The expense is a proper one but should certainly be closely supervised.

There is a tendency for us to be reasonably easy prey for concerns putting out employes' courses and selling services directed toward the building-up of efficiency, loyalty and morale among our employes. Last year we spent $1,500 for one course of this kind and, while we felt that we received many excellent things from it, we declined to renew a similar service from the same company for this year.

Our company owns and operates about 200 motor vehicles. Complete record of the cost of operation of each vehicle is kept but rather recently we decided to assign to someone deemed competent the task of analyzing our transportation problems, with a view of securing more efficiency out of motor vehicles at lesser cost.

One of the first things this man discovered was the use of several personal cars by employes on a mileage basis which was producing for those employes a monthly check in each case about equivalent to his regular pay check. The use of cars to this extent, of course, indicated the necessity of a company-owned car, at a material saving in cost.

Employes are prone to make trips to various places or exchanges in company cars where there is only one employe to go. This trip could be made by train or bus at a cost of one-third the expense of operating the automobile.

Checking of these practices is bound to result in a saving of expense and a consequent increase of net profits.

Another example of the necessity of careful scrutiny of small items has recently been related to me.

A small-town banker residing in a territory served by one of the larger telephone companies, who had been thinking up ways of increasing his profits, decided that he should make a service charge for handling the telephone company account. He proposed a very nominal charge of $2 per month and talked it over with a local manager, who inclined a sympathetic ear because of the nominal sum involved.

This banker proceeded to propose the charge at a meeting of his county bankers' association. All of the bankers readily agreed to the item, and it was proposed by all of these banks to the telephone company.

Two dollars per month seems very small, but spread over 250 banks in which this company carries its accounts, the item appears as $500 per month or $6,000 per year. If the small-town bank was entitled to $2 per month, the larger bank in the larger places might reasonably ask a much higher charge.

Now, such an item may afford just the opportunity you are looking for to cooperate with the banker. It may buy very valuable good will. I do not pass on this question; I merely cite it to show how an item trivial in itself may develop.

In conclusion, let me say that the history of increasing net profits is never properly told without emphasizing to you that no service can be permanently sold on a profitable basis, which does not give to the customer the fullest value for the dollar he pays.

Henry Ford in his book, "My Life and Work," says:

"We must always put service before profit. Without a profit, business cannot extend—but profit must and inevitably will come as a reward for good service. It cannot be the basis of service—it must be the result of service."

Because the telephone industry as a whole has recognized this principle and practiced it, the industry has prospered. Continued adherence to the ideal of service will gain further respect, inspire greater confidence, and insure peace and happiness to ourselves and our posterity.

District Telephone Meetings of Oklahoma Utilities Association.

A successful district telephone meeting of the telephone division, Oklahoma Utilities Association, was held at Broken Arrow, on November 20, under auspices of the Broken Arrow Chamber of Commerce, Broken Arrow Country Club and the Oklahoma Telephone Co. The new automatic telephone exchange of the Oklahoma Telephone Co. was formally opened and inspected in connection with the meeting. The total registration was 105. J. W. Walton, president of the Oklahoma Telephone Co., presided as toastmaster at the noonday luncheon.

Program features of the meeting included: Address of welcome by Dr. A. H. Stephens, pastor, First Presbyterian Church; response by O. D. Hall, Oklahoma City, assistant manager, Oklahoma Utilities Association; a reading by Miss Hemma Frazier, commercial and traffic superintendent, Oklahoma Telephone Co.; an address on "Telephone Service from the Public's Viewpoint," by F. S. Hurd, president, First National Bank, Broken Arrow, and response by H. M. Cox, Kansas City, Diversified Investments, Inc.; an address on "Contributions of Thomas A. Edison to the Telephone Industry," by H. W. Hubenthal, Oklahoma City, engineer, Oklahoma Utilities Association.

Sam Hand, Beggs, chairman, telephone division, presided at the business sessions. Among the subjects discussed were: "Rural Line Construction," "Maintenance, Service and Rates," "Rural Zone Service," "Association Activities," and "Local and Long Distance Service and Practices."

District meetings were also held at Gotebo on November 12 and at Frederick on November 14. Interesting programs were given at both places, similar to that at the Broken Arrow meeting. At Gotebo the attendance was 50 and at Frederick, 90.

Resolutions were adopted at both these meetings favoring the ownership of all telephone equipment by telephone companies engaged in giving service.

Laws of Potential Drop in Conductors

The Total Weight of Copper and Permissible Potential Drop in an Automatic Exchange "Ring Main" Circuit—Formulae Evolved With Actual Example of Application to Automatic Exchange Design—Part I. Mathematical Theory

By A. Prado,

Engineering Sales Department, Automatic Telephone Mfg. Co., Ltd., Liverpool, England

[AUTHOR'S FOREWORD: The subject matter of this article is divided into two parts. Part I deals with the mathematical theory of the subject, and Part II with its application in practice.

A brief summary embodying the results of the mathematical theory together with illustrative examples as applied in practice is given in Part II, thus enabling the reader to obtain all the information required without going too deeply into Part I.]

This Contribution by Mr. Prado Shows the Practical Application of Mathematical Theory in Determining Weight of Copper in "The Ring Main Circuit."

Symbols.

l, and l with suffix = Loop lengths in feet.

L = Loop length in feet of BFC, Fig. 2.

L' = Loop length in feet of BGC, Fig. 2.

I, and I with suffix = Current in amperes.

V, and V with suffix, and x, and x with suffix = Potential drops across various loop circuits.

a, and a with suffix = Sectional areas in square inches.

W, and W with suffix, and w, and w with suffix = Weights of copper in pounds.

k = A constant which takes into account specific resistance of copper and conversion of feet into inches.

Θ = Density of copper in lbs. per cu. in.

Definitions.

Actual Feeding Point of the Ring-Main Circuit: The actual feeding point of the ring-main circuit is the point where the main positive and negative conductors from the source of supply are connected.

Equipotential Point: The equipotential point in a ring-main circuit is a point which together with the actual feeding point divides the ring into two portions, such that when carrying a current, the algebraic sum of the potential drops in each portion is zero. Thus referring to Fig. 3, the potential drop in BFC is equal to the potential drop in BGC; hence C is the position of the equipotential point.

Normal Position of the Equipotential Point: The position of the equipotential point depends upon the nature of the load in the ring-main circuit, and its normal position is that occupied when both portions of the ring are fully loaded.

Portion of the Ring-Main Circuit: A portion of the ring-main is a loop circuit between the actual feeding point and the normal position of the equipotential point. BFC and BGC are each a portion of the ring-main (Fig. 3).

Section of the Ring-Main Circuit: A section of the ring-main is a loop circuit between two adjacent tapping points, or between a tapping point and the actual feeding point.

Ring-Main Circuit.

It has been shown by the author in an article entitled "Power Cabling of Automatic Plant" published in TELEPHONY, No. 26, Vol. 90, that the total weight of copper and subdivision of the permissible potential drop in an automatic telephone exchange power circuit are governed according to mathematical laws. A formula was evolved whereby the potential drop between the battery and the distribution point could be calculated, thus resulting in a minimum weight of copper in circuit.

Fig. 1 gives an illustration of the conditions under which the investigation was carried out, and the relation connecting total weight of copper in circuit and potential drop between battery and distribution point is according to the law,

$$x = \frac{v}{1 + \sqrt{K}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where $K = \dfrac{P_1 I_1 + P_2 I_2 + P_3 I_3 + \ldots + P_n I_n}{P I}$

The object of this article is to extend the investigation to what is known as the "Ring Main Circuit." The conditions which arise in this case are different to those illustrated in Fig. 1. We have to give consideration to a closed loop carrying a non-uniform current. The conditions are shown in Fig. 2.

If a conductor is to carry a uniform current, under a prescribed potential drop, then obviously the least amount of copper required will be obtained when the cross-section is uniform throughout. In a ring main circuit this is not so; the current is not uniform, therefore the cross-section cannot be uniform. This is the problem we have to solve.

We have to subdivide the drop across BC, according to mathematical laws, to insure a minimum weight of copper in the ring. But having done this we are only half-way through our problem, for we still have the portion AB to consider. The drop across AB is chained up, so to speak, with

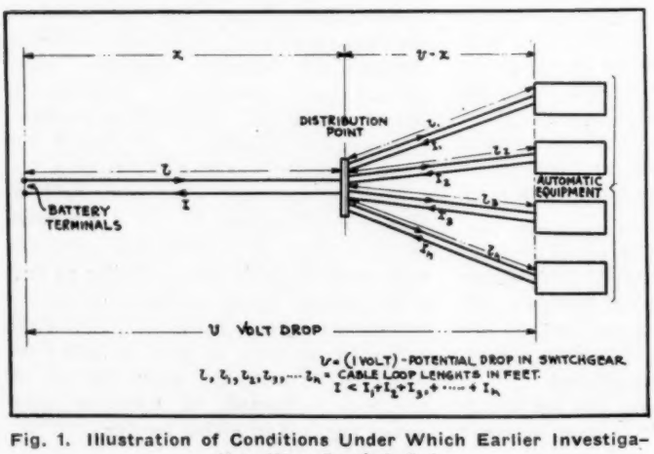


Fig. 1. Illustration of Conditions Under Which Earlier Investigation Was Carried Out.

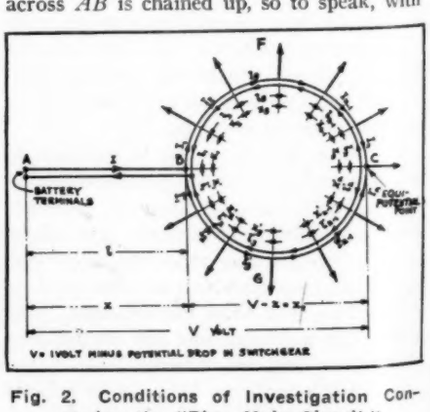


Fig. 2. Conditions of Investigation Concerning the "Ring Main Circuit."

the various drops in *BC*, to again insure a total minimum weight of copper in circuit.

Let us now examine the distribution of current in the ring.

Case I.

Consider each half-portion of the ring to be fully loaded, Fig. 3, and let the potential drop across *BFC* be equal to the potential drop across *BGC*. Under these conditions each half will draw its own current, wholly from the point *B*, so that there will be no exchange of current at *C*. *C* represents, therefore, the position of the equipotential point.

It should be noted that for the discussion in Case II, the drop in potential just referred to, is equal to some value *V'*.

Case II.

Let us now suppose the ring to be fully loaded on one side and completely unloaded on the other, Fig. 4. The loaded portion will be drawing current from both *B* and *C*, and under these conditions current will flow in the unloaded portion, passing the normal position of the equipotential point.

This current will continue to flow into the loaded portion until a tapping point is reached, where current is drawn from both directions.[1] This tapping point constitutes the new position of the equipotential point, as obviously, in order to obtain equilibrium as regards potential drop, current must be drawn from both sides.

[1]In order to simplify the discussion, the stipulation of a tapping point drawing current from both directions is made, though the load could be such that no potential difference exists between two adjacent tapping points, implying thereby that either of these is receiving current from one direction only.

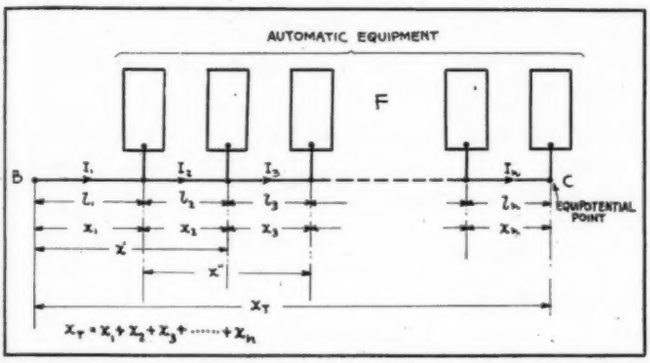


Fig. 5. Representation of Potential Drop Conditions in Portion of Ring Main Circuit.

Since current is drawn from both directions, the average value of the current in the loaded portion, between the actual feeding point, *B*, and equipotential point must be less than the average value of the current taken, under the conditions set forth in case 1. The potential drop must consequently be less than the value *V'*, particularly in view of the fact that the equipotential **point** has been shifted, resulting to an advantage as regards resistance of the circuit (see Fig. 4.)

The position of this point will tend towards its normal position as the load in the unloaded portion of the ring is increased. The position, therefore, depends upon the nature of the load, and under the conditions just stated the potential drop can never exceed the value *V'*.

We may now proceed with our mathematical investigations, in accordance with the conditions laid down under Case 1, because consideration must be given where the potential drop is likely to reach a maximum.

The potential drop across each half of the ring being equal, we may treat the portions *BFC* and *BGC* independently. Let us consider the portion *BFC* and let it be represented as shown in Fig. 5.

From *B* to *C* the value of the currents must be such that $I_1 > I_2 > I_3 > \ldots\ldots > I_{n-1} > I_n$.

If x_T is the potential drop across *BC* and $x_1, x_2, x_3 \ldots\ldots x_n$, the drops across the sections forming *BFC*, then

$$x_T = x_1 + x_2 + x_3 + \ldots\ldots + x_{n-1} + x_n \quad \ldots\ldots\ldots\ldots (2)$$

Furthermore, $x_1, x_2, x_3 \ldots\ldots x_n$ correspond to a minimum weight of copper in *BFC*.

Since the value of the currents in the first and second sections are such that $I_1 > I_2$, the cross-sectional area of the conductors forming these sections must be unequal, and corresponding to the potential drops x_1 and x_2, there must be a minimum weight of copper.

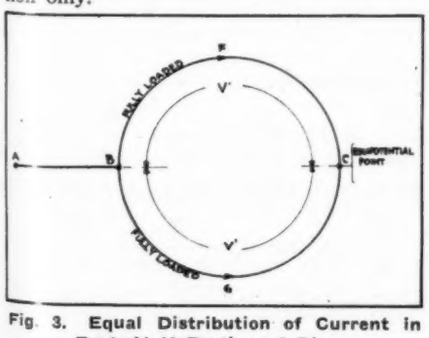


Fig. 3. Equal Distribution of Current in Each Half Portion of Ring.

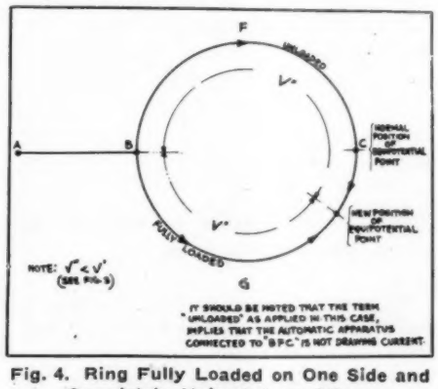

F
LOADED
V'
A
B
C
NORMAL POSITION OF EQUIPOTENTIAL POINT
V'
NEW POSITION OF EQUIPOTENTIAL POINT
FULLY LOADED
NOTE: V' < V' (SEE FIG. 5)
G
IT SHOULD BE NOTED THAT THE TERM "UNLOADED" AS APPLIED IN THIS CASE, IMPLIES THAT THE AUTOMATIC APPARATUS CONNECTED TO "B F C" IS NOT DRAWING CURRENT.

Fig. 4. Ring Fully Loaded on One Side and Completely Unloaded on Other.

If $x' = x_1 + x_2$ we have according to formula (1)

$$x_1 = \frac{x'}{1 + \sqrt{\frac{l_2^2 I_2}{l_1^2 I_1}}} = \frac{l_1 x' \sqrt{I_1}}{l_1\sqrt{I_1} + l_2\sqrt{I_2}} \quad \ldots\ldots (3)$$

and $x_2 = x' - \dfrac{l_1 x' \sqrt{I_1}}{l_1\sqrt{I_1} + l_2\sqrt{I_2}}$

$$= \frac{x' l_2 \sqrt{I_2}}{l_1\sqrt{I_1} + l_2\sqrt{I_2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

therefore, $\dfrac{x_1}{x_2} = \dfrac{\dfrac{l_1 x' \sqrt{I_1}}{l_1\sqrt{I_1} + l_2\sqrt{I_2}}}{\dfrac{x' l_2 \sqrt{I_2}}{l_1\sqrt{I_1} + l_2\sqrt{I_2}}}$

$$= \frac{l_1}{l_2}\sqrt{\frac{I_1}{I_2}}$$

Hence $x_2 = x_2 \dfrac{l_1}{l_2}\sqrt{\dfrac{I_1}{I_2}} \quad \ldots\ldots\ldots\ldots (5)$

If we consider the second and third sections, we have by a similar reasoning,

$$x_2 = \frac{x''}{1 + \sqrt{\frac{l_3^2 I_3}{l_2^2 I_2}}}$$

$$= \frac{l_2 x'' \sqrt{I_2}}{l_2\sqrt{I_2} + l_3\sqrt{I_3}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

and $x_2 = x'' - \dfrac{l_2 x'' \sqrt{I_2}}{l_2\sqrt{I_2} + l_3\sqrt{I_3}}$

$$= \frac{l_3 x'' \sqrt{I_3}}{l_2\sqrt{I_2} + l_3\sqrt{I_3}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

From (6) and (7) we have

$$\frac{x_2}{x_3} = \frac{l_2}{l_3}\sqrt{\frac{I_2}{I_3}}$$

Hence $x_2 = x_2 \dfrac{l_2}{l_3}\sqrt{\dfrac{I_2}{I_3}} \quad \ldots\ldots\ldots\ldots\ldots (8)$

In a similar manner we deduce,

$$\frac{x_3}{x_4} = \frac{l_3}{l_4}\sqrt{\frac{I_3}{I_4}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Hence $x_3 = x_4 \dfrac{l_3}{l_4}\sqrt{\dfrac{I_3}{I_4}} \quad \ldots\ldots\ldots\ldots\ldots (10)$

Also $x_{n-1} = \dfrac{l_{n-1}}{l_n}\sqrt{\dfrac{I_{n-1}}{I_n}} \quad \ldots\ldots\ldots\ldots (11)$

Hence $x_{n-1} = x_n \dfrac{l_{n-1}}{l_n}\sqrt{\dfrac{I_{n-1}}{I_n}} \quad \ldots\ldots\ldots (12)$

By successive substitution we have

$$x_1 = \frac{l_1}{l_2}\sqrt{\frac{I_1}{I_2}}\,\frac{l_2}{l_3}\sqrt{\frac{I_2}{I_3}}\,\frac{l_3}{l_4}\sqrt{\frac{I_3}{I_4}} \ldots\ldots x_n \frac{l_{n-1}}{l_n}\sqrt{\frac{I_{n-1}}{I_n}}$$

so that

$$x_1 = \frac{l_1}{l_n}\sqrt{\frac{I_1}{I_n}}\,x_n \quad \ldots\ldots\ldots\ldots\ldots (13)$$

It may be shown that,

$$x_2 = \frac{l_2}{l_n}\sqrt{\frac{I_2}{I_n}}\,x_n \quad \ldots\ldots\ldots\ldots\ldots (14)$$

$$x_3 = \frac{l_3}{l_n}\sqrt{\frac{I_3}{I_n}}\,x_n \quad \ldots\ldots\ldots\ldots\ldots (15)$$

$$\text{and } x_{n-1} = \frac{l_{n-1}}{l_n}\sqrt{\frac{I_{n-1}}{I_n}}\,x_n \quad \ldots\ldots\ldots\ldots (16)$$

Now $x_T = x_1 + x_2 + x_3 + \ldots\ldots + x_{n-1} + x_n$.

Substituting the values of x_1, x_2, x_3 and x_{n-1}, we have

$$x_T = \frac{l_1}{l_n}\sqrt{\frac{I_1}{I_n}}\,x_n + \frac{l_2}{l_n}\sqrt{\frac{I_2}{I_n}}\,x_n + \frac{l_3}{l_n}\sqrt{\frac{I_3}{I_n}}\,x_n + \ldots\ldots + \frac{l_{n-1}}{l_n}\sqrt{\frac{I_{n-1}}{I_n}}\,x_n + x_n \quad \ldots\ldots\ldots\ldots\ldots\ldots (17)$$

By factorization,

$$x_T = \frac{x_n}{l_n\sqrt{I_n}}\,[l_1\sqrt{I_1} + l_2\sqrt{I_2} + l_3\sqrt{I_3} + \ldots\ldots + l_{n-1}\sqrt{I_{n-1}} + l_n\sqrt{I_n}] \quad (18)$$

If we write,

$$P = l_1\sqrt{I_1} + l_2\sqrt{I_2} + l_3\sqrt{I_3} + \ldots\ldots + l_{n-1}\sqrt{I_{n-1}} + l_n\sqrt{I_n}$$

(18) can be written in the form,

$$x_T = \frac{P\,x_n}{l_n\sqrt{I_n}} \quad \ldots\ldots\ldots\ldots\ldots (19)$$

$$\text{therefore } x_n = x_T\frac{l_n\sqrt{I_n}}{P} \quad \ldots\ldots\ldots\ldots (20)$$

Substituting (20) in (13), (14), (15) and (16) we have

$$x_1 = \frac{l_1}{l_n}\sqrt{\frac{I_1}{I_n}}\,x_T\,\frac{l_n\sqrt{I_n}}{P}$$

$$\text{or } x_1 = x_T\frac{l_1\sqrt{I_1}}{P} \quad \ldots\ldots\ldots\ldots\ldots (21)$$

and similarly,

$$x_2 = x_T\frac{l_2\sqrt{I_2}}{P} \quad \ldots\ldots\ldots\ldots\ldots (22)$$

$$x_3 = x_T\frac{l_3\sqrt{I_3}}{P} \quad \ldots\ldots\ldots\ldots\ldots (23)$$

$$x_{n-1} = x_T\frac{l_{n-1}\sqrt{I_{n-1}}}{P} \quad \ldots\ldots\ldots\ldots (24)$$

The value of x_n we have already worked out, namely, $x_n = x_T\frac{l_n\sqrt{I_n}}{P}$ ..... (25)

(25) is the general formula for calculating the potential drop in the various sections of *BFC*; for in view of the symetry of the suffix numbers of formulae (21) to (24), we may deduce any of these by merely writing 1. 2. 3.....n-1 for n in (25).

The potential drop across *BGC* and *BFC* being equal, we may compute the drop across any section of *BGC* by formula (25). Hence we have for the portion *BGC*, the general formula:

$$x'_n = x_T\frac{l'n\sqrt{I'n}}{P'} \quad \ldots\ldots\ldots\ldots\ldots (26)$$

It should be noted that actually there is only one formula. Formula (26) has been introduced to merely comply with the symbols shown in the portion *BGC* of Fig. 2. In the second part of this article formula (25) only will be given.

We have now established the law connecting potential drop and weight of copper in the ring, and by the help of the general formula we can arrive at the best possible results, in order to insure that this weight may be a minimum.

The right hand side of the general formula depends upon:

(a) The constants of the circuit; that is, the various currents and length of the sections forming the ring.

(b) The potential drop across the ring.

We know (a), but we have to determine (b). The potential drop across the ring depends upon the constants of the ring main, the constants of the circuit *AB*, and the total available potential drop[3] across the entire circuit.

By a suitable formula involving these constants and total drop, we can calculate x_T', in order to insure a total minimum weight of copper.

The determination of this formula is the next step. If V is the potential drop across *AC* (Fig. 2), and x the drop across *AB, then,*

$$x_T = V - x \quad \ldots\ldots\ldots\ldots\ldots (27)$$

The weight of copper, w, between A and B is,

$$w = 12\,k\,\Theta\frac{l^2 I}{x} \quad \ldots\ldots\ldots\ldots (28)[4]$$

The weight of copper w_1, in the first section of *BFC* is,

$$w_1 = 12\ k\ \Theta\ \frac{l^2_1 I_1}{x_1}$$

$$\text{and since } x_1 = x_T\frac{l_1\sqrt{I_1}}{P} = (V-x)\frac{l_1\sqrt{I_1}}{P}$$

$$\text{we have } w_1 = \frac{12\,k\,\Theta\,l^2_1 I_1}{(V-x)\,l_1\sqrt{I_1}}\,P$$

$$w_1 = \frac{12\,k\,\Theta\,l_1\sqrt{I_1}P}{V-x} \quad \ldots\ldots\ldots\ldots (29)$$

In a similar manner we have for the second, third and nth section,

$$w_2 = \frac{12\,k\,\Theta\,l_2\sqrt{I_2}P}{V-x} \quad \ldots\ldots\ldots\ldots (30)$$

$$w_3 = \frac{12\,k\,\Theta\,l_3\sqrt{I_3}P}{V-x} \quad \ldots\ldots\ldots\ldots (31)$$

$$w_n = \frac{12\,k\,\Theta\,l_n\sqrt{I_n}P}{V-x} \quad \ldots\ldots\ldots\ldots (32)$$

The total weight of copper, w' in *BFC* is:

$$w' = w_1 + w_2 + w_3 + \ldots\ldots + w_n \quad \ldots\ldots (33)$$

Substituting formulae (29) to (32) in (33), we have

$$w' = \frac{12\,k\,\Theta\,l_1\sqrt{I_1}P}{V-x} + \frac{12\,k\,\Theta\,l_2\sqrt{I_2}P}{V-x} + \frac{12\,k\,\Theta\,l_3\sqrt{I_3}P}{V-x} + \ldots\ldots + \frac{12\,k\,\Theta\,l_n\sqrt{I_n}P}{V-x}$$

$$\text{or } w' = \frac{12\,k\,\Theta\,P}{V-x}\,(l_1\sqrt{I_1} + l_2\sqrt{I_2} + l_3\sqrt{I_3} + \ldots\ldots + l_n\sqrt{I_n}) \quad \ldots\ldots\ldots (34)$$

But $P = l_1\sqrt{I_1} + l_2\sqrt{I_2} + l_3\sqrt{I_3} + \ldots\ldots + l_n\sqrt{I_n}$, hence (34) can be written in the form,

$$w' = \frac{12\,k\,\Theta\,P^2}{V-x} \quad \ldots\ldots\ldots\ldots\ldots (35)$$

If w'' denotes the total weight of copper in *BGC*, it can be shown in a similar manner that,

$$w'' = \frac{12\,k\,\Theta\,P'^2}{V-x} \quad \ldots\ldots\ldots\ldots\ldots (36)$$

The total weight of copper, W, in the entire circuit *AC* is,

$$W = w + w' + w'' \quad \ldots\ldots\ldots\ldots\ldots (37)$$

Substituting formulae (28), (35) and (36) in (37), we have,

$$W = \frac{12\,k\,\Theta\,l^2 I}{x} + \frac{12\,k\,\Theta\,P^2}{V-x} + \frac{12\,k\,\Theta\,P'^2}{V-x}$$

$$\text{or } W = 12\,k\,\Theta\left(\frac{l^2 I}{x} + \frac{P^2 + P'^2}{V-x}\right) \quad \ldots (38)$$

If in (38), we write $l^2 I = M$ and $P^2 + P'^2 = N$, we have

$$W = 12\,k\,\Theta\left(\frac{M}{x} + \frac{N}{V-x}\right) \quad \ldots\ldots\ldots (39)$$

Differentiating,

$$\frac{dW}{dx} = 12\,k\,\Theta\left(\frac{N}{(V-x)^2} - \frac{M}{x^2}\right) \quad \ldots (40)$$

We have a minimum weight of copper for,

$$\frac{dW}{dx} = 0, \text{ that is, } \frac{N}{(V-x)^2} - \frac{M}{x^2} = 0$$

which can be written,

$$(N-M)\,x^2 + 2VMx - V^2M = 0$$

[3] This is equal to one volt less drop in switchgear, shunts and power board busbars.

[4] See author's article in TELEPHONY, Vol. 90, No. 26, June 26, 1926.

Solving this quadratic equation, we have for the roots,

$$x = -\frac{VM}{N-M} \pm \frac{V\sqrt{MN}}{N-M} \quad \ldots\ldots\ldots (41)$$

We find that the positive sign gives the condition for a minimum,

$$\text{therefore, } x = V\left(\frac{\sqrt{MN}-M}{N-M}\right)$$

which can be simplified to,

$$x = \frac{V}{1+\sqrt{\frac{N}{M}}} \quad \ldots\ldots\ldots\ldots\ldots (42)$$

Substituting the values for M and N in (42), we have

$$x = \frac{V}{1+\sqrt{\left(\frac{P^2+P'^2}{I^2I}\right)}} \quad \ldots\ldots (43)$$

All factors on the right hand side of (43) are known, so that x can be determined.

The value of x_T can now be calculated from the relation $x_T = V - x$, that is,

$$x_T = V - \frac{V}{1+\sqrt{\left(\frac{P^2+P'^2}{I^2I}\right)}}$$

$$\text{Hence } x_T = \frac{\sqrt{P^2+P'^2}V}{\sqrt{I^2I}+\sqrt{P^2+P'^2}} \quad \ldots\ldots (44)$$

Dividing both numerator and denominator of (44) by $\sqrt{P^2+P'^2}$

$$\text{we have } x_T = \frac{V}{1+\sqrt{\frac{I^2I}{P^2+P'^2}}} \quad \ldots\ldots (45)$$

Formula (45) gives the potential drop across the ring, so that the drop across the various sections forming the ring main can be determined by formula (25). Knowing the various potential drops in the whole circuit, the cross-sectional area of the sections can be calculated.

Theorem.

In a ring-main circuit the cross-sectional area of the conductor forming any section, between the actual feeding point and the normal position of the equipotential point, must be less than the cross-sectional area of the conductor forming the preceding section.

Proof.

Between the actual feeding point and the normal position of the equipotential point, we have under fully loaded conditions,

$$I_1 > I_2 > I_3 > \ldots\ldots > I_{n-1} > I_n$$

Let us consider a section of the ring-main across which the potential drop is x_2. The potential drop across the preceding section will be x_1.

If a_2 denotes the area corresponding to x_2, and a_1 the area corresponding to x_1,

we have $$a_2 = \frac{kl_2I_2}{x_2}$$

but $$x_2 = x_T\frac{l_2\sqrt{I_2}}{P}$$

Therefore $$a_2 = \frac{kP\sqrt{I_2}}{x_T}$$

In a similar manner, $a_1 = \frac{kP\sqrt{I_1}}{x_T}$

Now $I_1 > I_2$, hence $\frac{kP\sqrt{I_1}}{x_T} > \frac{kP\sqrt{I_2}}{x_T}$,

therefore $a_2 < a_1$ Q. E. D.

Corollary 1.

$$\frac{a_2}{a_1} = \sqrt{\frac{I_2}{I_1}}$$

hence $$a_2 = a_1\sqrt{\frac{I_2}{I_1}} \quad \ldots\ldots (46)$$

similarly $$a_3 = a_2\sqrt{\frac{I_3}{I_2}} \quad \ldots\ldots (47)$$

and in a general form,

$$a_n = a_{n-1}\sqrt{\frac{I_n}{I_{n-1}}} \quad \ldots\ldots (48)$$

Corollary 2.

Having the sectional area of the conductor forming the first section of the ring main, we can compute[4] the sectional area of the conductor forming any other section, between the actual feeding point and the normal position of the equipotential point.

Although we have shown mathematically that a ring-main circuit cannot have a uniform cross-section in the portions BFC and BGC, if a minimum weight of copper is to be ensured, it does not follow that we should condemn altogether the idea of having a uniform cross-section.

In a large exchange, formulae (25) and (26) will certainly meet their application for the calculation of the potential drop across the various sections forming the ring-main.

On the other hand, in the case of a small exchange the economy entailed by the use of formulae (25) and (26), compared to a uniform cross-section method of calculation, may be such that the uniform method might prove to be the better proposition. The reason for this will be explained later.

We will now proceed to find suitable formulae whereby the uniform cross-section method of calculation may be treated.

Referring again to Fig. 2 we have,

$$x_T = x_1 + x_2 + x_3 + \ldots\ldots + x_n \quad \ldots\ldots (49)$$

Let

$$x_1 = \frac{kl_1I_1}{a} \quad \ldots\ldots\ldots\ldots (50)$$

$$x_2 = \frac{kl_2I_2}{a} \quad \ldots\ldots\ldots\ldots (51)$$

$$x_3 = \frac{kl_3I_3}{a} \quad \ldots\ldots\ldots\ldots (52)$$

$$x_n = \frac{kl_nI_n}{a} \quad \ldots\ldots\ldots\ldots (53)$$

Substituting (50), (51), (52), and (53) in (49), we have

$$x_T = \frac{kl_1I_1}{a} + \frac{kl_2I_2}{a} + \frac{kl_3I_3}{a} + \ldots\ldots + \frac{kl_nI_n}{a}$$

or

$$x_T = \frac{k}{a}(l_1I_1 + l_2I_2 + l_3I_3 + \ldots\ldots + l_nI_n) \quad (54)$$

hence

$$a = \frac{k}{x_T}(l_1I_1 + l_2I_2 + l_3I_3 + \ldots\ldots + l_nI_n) \quad \ldots (55)$$

If we write in (55),

$Q = l_1I_1 + l_2I_2 + l_3I_3 + \ldots\ldots + l_nI_n$ we have $a = \frac{kQ}{x_T}$ $\ldots\ldots (56)$

Total length in feet of BFC is

$$L = (l_1 + l_2 + l_3 + \ldots\ldots + l_n)$$

Weight of copper in BFC, in pounds, is

$$w'_1 = 12\,\Theta\,a\,L \quad \ldots\ldots (57)$$

where Θ = density of copper in pound per cubic inch.

Substituting (56) in (57), we have,

$$w'_1 = \frac{12\,k\,\Theta\,QL}{x_T} \quad \ldots\ldots (58)$$

We can show in a similar manner that the weight of copper in BGC is

$$w'_2 = \frac{12\,k\,\Theta\,Q'L'}{x_T} \quad \ldots\ldots (59)$$

where

$Q' = l'_1I'_1 + l'_2I'_2 + l'_3I'_3 + \ldots\ldots + l'_nI'_n$ and

$L' = l'_1 + l'_2 + l'_3 + \ldots\ldots + l'_n$

Weight of copper between A and B is

$$w = \frac{12\,k\,\Theta\,I^2I}{x} \quad \ldots\ldots (60)$$

If W' denotes the total weight of copper in the entire circuit we have

$$W' = w + w'_1 + w'_2 \quad \ldots\ldots (61)$$

Substituting (58), (59), (60), in (61) and replacing x_T by $V - x$ we have,

$$W' = 12\,k\,\Theta\left(\frac{I^2I}{x} + \frac{QL + Q'L'}{V-x}\right) \quad \ldots (62)$$

Writing $I^2I = M'$ and $QL + Q'L' = N'$ we have

$$W' = 12\,k\,\Theta\left(\frac{M'}{x} + \frac{N'}{V-x}\right) \quad \ldots\ldots (63)$$

Differentiating,

$$\frac{dW'}{dx} = 12\,k\,\Theta\left(\frac{N'}{(V-x)^2} - \frac{M'}{x^2}\right) \quad \ldots\ldots (64)$$

We have a minimum weight of copper for,

$\frac{dW'}{dx} = 0$, that is $\frac{N'}{(V-x)^2} - \frac{M'}{x^2} = 0$ or

$(N'-M')x^2 + 2\,VM'x - V^2M' = 0.$

$$\text{The root } x = \frac{V}{1+\sqrt{\frac{N'}{M'}}} \quad \ldots\ldots (65)$$

satisfies the condition for a total minimum

[4] By successive application of (48).

weight of copper. Substituting the values for M' and N' in (65), we have

$$x = \frac{V}{1+\sqrt{\frac{QL+Q'L'}{PI}}} \quad \ldots\ldots\ldots\ldots (66)$$

since $x_T = V - x$

we deduce $x_T = \frac{V}{1+\sqrt{\frac{PI}{QL+Q'L'}}} \quad \ldots (67)$

Having determined the value of x_T the cross-section of BFC and BGC, respectively, can be calculated by means of formula (56).

We have, therefore,

$$a = \frac{kQ}{x_T} \text{ for } BFC$$

$$\text{and } a' = \frac{kQ'}{x_T} \text{ for } BGC.$$

The "uniform cross-section" method of calculation offers a more simple way of working, compared to the "non-uniform" method. With the "uniform" method, once the voltage drop x_T has been calculated, the cross-section of BFC and BGC can be worked out.

In the non-uniform method, we determine the voltage drop x_T, subdivide this voltage drop, and then calculate the cross-section of the various sections forming the ring-main. It certainly leads to more economical conditions as regards saving of copper, compared to the "uniform" method. At the same time in the case of a small exchange, the saving of copper may be such that economy is effected at the expense of construction.

For this reason the "uniform" method is recommended at the present stage for all exchanges, as the application of the "non-uniform" method is penalized by the limitation of commercial copper sections particularly in the case of small exchanges.

Until more data is available regarding the application of the "non-uniform" method, a line of demarcation cannot be drawn.

As to the mathematical properties of formulae (35) and (63), these are very similar to those enumerated in connection with formula (18) of the author's former work referred to at the beginning of this article. It is not, therefore, considered necessary to spend any time on this subject, in view of the fact that the information can be obtained from TELEPHONY.

We now come to the determination of the normal position of the equipotential point. Theoretically, the position of this point implies certain mathematical conditions, the fulfillment of which, requiring that the values of P and P' should be such, that in the case of the non-uniform method, $P^2 + P'^2$ in formula (38) is a minimum; or in the case of the uniform method the values of QL and $Q'L'$ should be such that $QL + Q'L'$ in formula (62) is a minimum. This, however, entails extremely laborious calculations, apart from the fact that the conditions are very difficult to realize in practice. We are thus compelled to depart from these ideal conditions.

By an approximate method of calculation,[8] we can determine the normal position of the equipotential point, by adjusting the currents and lengths of BFC and BGC (Fig. 2), so that the difference, $LI_1 - L'I'_1$ may be as small as possible. This is indeed an approximation to the condition, $LI_1 = L'I'_1$.

(To be continued.)

[8]This applies to either the non-uniform or the uniform method.

Commercial Telephone Service Established with Ship at Sea.

Ship-to-shore radiotelephone communication on a commercial basis was inaugurated at 11 a. m. on Sunday, December 8. At that time telephone communication was established with the United States liner "Leviathan," while on the high seas about 200 miles out, Europe bound.

Under the system thus opened, any one of the 20,000,000 telephones in the United States is available for direct conversations with the "Leviathan" while en route to or from Europe, and at any stage of the voyage up to a distance of about 1,500 miles from New York City under good atmospheric conditions. The vessel has been equipped with the radiotelephone apparatus by the American Telephone & Telegraph Co. Other vessels will be equipped for service as the demand warrants it.

The new commercial telephone service to ship at sea was inaugurated with an exchange of formal greetings between Walter S. Gifford, president of the American Telephone & Telegraph Co., in his office in New York City, and Commodore H. A. Cunningham aboard the Leviathan. About two dozen invited guests were present at the A. T. & T. headquarters in New York City and participated in the 20 minutes of uninterrupted conversation—perfect technically, at least—which followed.

The circuit was completed from New York City by land wire to the radio sending station at Deal Beach, N. J.; across 200 miles of water to the ship, and back again by way of the receiving station at Forked River, N. J.

At the conclusion of the conversations of the New York group, the land circuit was connected with Washington, D. C. There Representative Fred Britten of Illinois, chairman of the House committee on naval affairs, after the customary pleasantries on the weather and the perfection of the reception, read a formal speech of congratulation.

The first commercial call was made from Atlantic City, N. J., by William H. Rankin, a guest at the Hotel Chalfonte there, to Sir Thomas Lipton aboard the Leviathan. Sir Thomas, who will return next June with the Shamrock V, declared that the thrill he experienced in the conversation could only be exceeded by capture of the America's Cup, according to Mr. Rankin.

The conversations from the Leviathan were carried on in a room set aside for the purpose on the "B" deck. The Leviathan has the largest telephone exchange afloat, but the ship-to-shore service has not yet been connected with the telephones in the staterooms. It is believed, however, that later the connections can be made direct to staterooms through this system.

The rates for calls to the Leviathan vary from $21 for the first three minutes and $7 for each extra minute to $33 with $11 for each extra minute, depending upon the part of the country in which the shore telephone is located.

British telephone subscribers are not in position to use the new ship-to-shore telephone service of the Leviathan according to a dispatch from London. As communication on the European side will be between the Leviathan and the experimental station which has been erected near Paris or that being constructed in Spain, British subscribers would have to depend on extensive linking up of underwater cables between the Continent and London.

Until the British postoffice has set up its own receiving station, service to transatlantic liners probably will not be open to British subscribers.

On the White Star liner Olympic which sailed for America on Wednesday, December 11, final tests in wireless telephone service between the ship and Paris and New York were to be carried out. On this trip, a series of trials were to be held to determine the amount of ship-to-shore telephone traffic which may be expected on modern transatlantic liners.

The American Telephone & Telegraph Co. recently was authorized to utilize five frequencies in the mobile high frequency bands for maintenance on the commercial service, which is the first of its kind in the world. An outline of the development of this service and the problems encountered was published in last week's issue of TELEPHONY.

Canadian Bell Divides Territory Into Two Operating Areas.

The Bell Telephone Co. of Canada has divided its territory into two operating areas. Beginning January 1, 1930, Montreal will continue to be the executive headquarters, but the provinces of Ontario and Quebec will comprise two independent operating areas, each with its own general manager and complete administrative and engineering staffs.

All of the Ontario territory west of Trenton will fall under the Toronto office of the company, while Montreal will continue to be headquarters for eastern Ontario and Quebec.

Here and There in Telephone Work

Inter-Mountain Employes Entertained at Hallowe'en Banquet.

The Inter-Mountain Telephone Co., Bristol, Tenn., held its third annual Hallowe'en banquet at the Bristol Elks Club on October 31, with President W. N. McAnge, Jr., as host. Each of the company's 21 exchanges was represented by one or more persons.

After welcoming the attendants, and introducing department heads, managers and chief operators, Mr. McAnge called upon A. U. Meadows, general commercial manager of the Inter-Mountain company, to give an account of the growth of the company since the last banquet held at the John Sevier hotel in Johnson City, in 1928.

Mr. Meadows told of the growth of the system from 12,760 stations in October, 1928, to its present number of 14,652. He said that a goal of the company was to have 15,000 stations by January 1, 1930, and said he was more than confident that this quota would not only be reached but exceeded. He stated that during the last two months of 1928 a gain of 478 stations was shown, and that to reach the goal set for this year only 378 net gain was needed.

Mr. Meadows described the "Straight '8' Campaign," covering in detail the factors that brought about the name for the drive. The goal was set at 800 stations, with eight classes of service to sell, eight monthly prizes of $5.00 each, and the "Straight '8' Club." At the time of the banquet, 32 employes of the Inter-Mountain company had qualified as members of the club.

Entertainment during the course of the dinner was furnished by the "Alabamians," a dance orchestra of Bristol, Tenn., and the "Hill Billies," a string quartet. Mrs. William Hankins of Johnson City gave two vocal solos, accompanied by Mrs. Harry Burbage, also of Johnson City, at the piano. Following the banquet dancing was enjoyed for several hours.

"Wonder Whys" of an Observing Traveling Telephone Engineer.

By Ray Blain

I wonder why so many telephone companies will continue to use old rough carbon blocks, and micas with edges all broken and burned, when adequate protection is such an important item in a telephone exchange.

Many carbon blocks are ruined because about the same care is exercised in cleaning them by the maintenance force as is generally exercised in cleaning bricks with a hatchet. Many think that a block can be cleaned by rubbing it on a piece of sandpaper. In reality this ruins the special dustless surface of the carbon so that it grounds very easily; also the adjustment between the blocks will be altered so that the breakdown value is changed.

Personally I never enjoyed the operation of assembling the two carbons and micas and then inserting correctly in the main frame. Due to the difficulty of this operation, in many cases the blocks are not installed in a manner to insure adequate protection.

There are on the market various types of protector blocks that discard the mica and are even more efficient in their operation. Some have a self-cleaning feature that is desirable. Any expenditure that will insure adequate protection at all times is justified, for this is only cheap insurance of costly equipment.

The Magneto Exchange Repairman; the Switchboard.

By J. A. Bracken

There are several types of switchboards used in a magneto telephone exchange, the

The Third Hallowe'en Party of the Inter-Mountain Telephone Co. Held at Bristol, Tenn., Was Attended by More Than 250 Employes and Invited Guests. Awards Were Made to Employes for Records Attained in Developing New Business.

most common of which are the self-restoring and the manual-restoring type, where each subscriber's line occupies but one terminal connection and where all the lines can be reached by one operator. This type of switchboard usually has a limited capacity of not over a few hundred lines.

The first essential for maintaining a magneto switchboard is a familarity with the circuits and functions of the apparatus comprising it. The variety of faults or troubles that can develop in a switchboard are many. These troubles may be divided into two classes: Those where the apparatus fails to operate or perform the mechanical functions they are designed for and intended to meet, aside from the transmission of speech; and second, the failure to transmit speech at all, or only very poorly.

The equipment on a manually-restoring switchboard provides for a connecting terminal or switch known as a jack, and a call signal adapted to be operated by an electric current from a magneto generator at the subscriber's station. The jack may be one of many forms but always includes a cylindrical opening in the face of the switchboard and back of which is placed one or more contact springs.

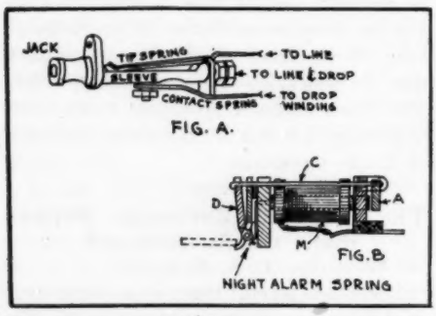


Fig. 1. Elements of the Magneto Jack and of Manually-Restored Drop.

The plug adapted to be used in connection with this jack has two contact parts (tip and sleeve) arranged so that when the plug is inserted in the jack the corresponding parts will come in contact and extend the line circuit from the jack to the conductors of the cord terminating in the plug.

In this type of switchboard the plugs are equipped in pairs so that a connection between subscribers' lines must be made through two jacks, two plugs and two flexible cords. A simple form of a jack is shown in Fig. 1-A, consisting of a brass casting forming the cylinder opening which is usually one of the main terminals of the jack and is called the thimble or sleeve.

A contact of spring metal is fastened to the sleeve but insulated from it. This is known as the tip spring, since it engages the tip of the plug. A third terminal called the cut-off spring is provided on the jack. It is normally in contact with the tip spring but is insulated from other parts of the jack.

The signal device associated with the subscriber's line, usually takes the form of an electric magneto annunciator or drop, consisting of an electromagnet whose winding is connected to the line circuit. The connection between the drop and the line is made through the cut-off contact spring just described, so that when the plug is inserted in the jack the drop is disconnected.

There are several types of these drops, but the one shown in Fig. 1-*B* illustrates the operations of a commonly used manually restored type. In this type, the alternating current from the subscriber's magneto generator gives a pulsating magnetization of the magnet, *M*. This attracts the armature, *A*, and releases the shutter, *D*, normally held in position by a long, light arm, *C*, attached to the armature which drops down displaying before the operator the number of the line to which the drop belongs.

We will now examine the various operations involved in establishing connections between two telephone connected to the switchboard. In Fig. 2-*A* is shown a circuit of the ordinary magneto telephone station circuit and the exchange line circuit. Desiring to attract the attention of the operator, the subscriber turns the crank of the magneto generator, sending an alternating current through the line circuit. This incoming alternating current can be traced from the point, *T*, to the jack tip spring, to the contact spring, and thence to the drop winding; through this winding to the sleeve of the jack and back to the station generator at point *R*.

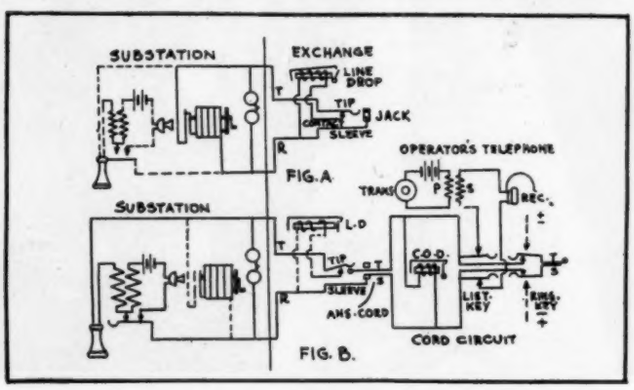


Fig. 2. Magneto Telephone Station Circuit and Exchange Line Circuit with Condition When Cord Circuit Is Connected.

The drop shutter, being released, falls forward attracting the attention of the operator and she inserts a plug of an idle cord circuit pair in the jack of the calling line. By a cord circuit is meant a pair of flexible connecting cords and plugs and other associated apparatus, such as ringing keys, listening keys, clearing-out drops, etc., and arranged for making a connection.

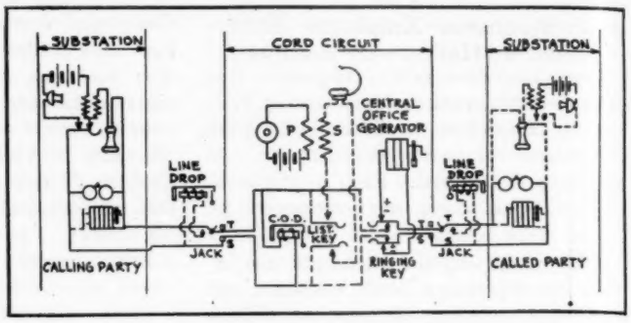


Fig. 3. Circuit from Calling Magneto Telephone Through Switchboard and Cord Circuit to Called Station.

The insertion of the cord plug in the jack sets up the condition shown in Fig. 2-*B*. The drop is thus disconnected from the line and the operation of the cord circuit listening key extends the connection to the operator's telephone set circuit. This circuit enables the operator to converse with the subscribers and supervise connections.

After inquiring the number of the desired party, the operator inserts the other plug of the same cord pair into the jack of the called party and operates the ringing key, thus setting up the condition shown in Fig. 3.

The bell of the called subscriber being rung by the operator, the subscriber removes the receiver from the hook, completing the circuit between the two subscribers. The only thing that remains to be done then is to signal the operator at the close of the conversation so that she may know when to disconnect the lines without listening to conversations.

This is provided for by leaving the drop, known as "clearing-out drop," bridged across the cord circuit so that it can be operated by generator current from either subscriber's station. Upon seeing the shutter of the "clearing-out drop" fall, the operator removes the plugs of the cord circuit from the jacks of the subscribers' lines, restoring all parts to their original condition.

The "clearing-out drop" and the ringers in the subscribers' stations remain bridged across the circuit during the conversation but are of such high resistance and self-induction that they offer practically no path for the rapidly-fluctuating voice currents from one side of the line to the other.

The only currents passing over the line during the conversation are alternating currents generated in the induction coils of the

subscribers' stations. It will be seen that at any time the operator may press the listening key, connecting the circuit of her telephone to the cord circuit, and listen to the conversation or talk to either subscriber as may be necessary.

Special Service to War Department in Event of Emergency.

The U. S. War Department has entered into an emergency telephone agreement with American Telephone & Telegraph Co. to care for augmentation of telephone service and facilities in the event of a national emergency, Major General George S. Gibbs, chief signal officer, recently disclosed in his annual report.

Under this agreement, the Bell system will provide the necessary telephone service, including long distance circuits, upon issuance of a request or order by corps area signal officers concerned.

General Gibbs reported rapid progress in the extension of radio plant to meet the increased traffic requirements in the War Department and corps area radio networks. Increase in radio traffic over the preceding year has been approximately 12 per cent. Total value of the business of this department for 1928-1929 was $366,493.

Personal Notes from the Field

Theodore Gary, of Kansas City, has been elected treasurer of the Republican senate campaign committee. His name was proposed by Senator Roscoe Patterson of Missouri, a member of the committee. He takes the place of Otto H. Kahn of New York, who was originally selected by Senator Moses of New Hampshire, chairman of the committee, but who withdrew after he had been the target of attacks by western senators.

It is understood that choice of Mr. Gary was approved by President Hoover and Chairman Huston of the national committee. He has acted as treasurer of a regional committee of the Republican National Committee on several occasions.

Mr. Gary is an intimate friend of the former President Coolidge and is well known among the farmers of the Middle West where he began his career by selling lightning rods and farm machinery. He then engaged in the Independent telephone industry and has been prominent in it for many years, not only in this country but abroad.

J. G. Ihmsen, of Albany, N. Y., president of the Up-State Telephone Association of New York, sailed on December 14 on the S. S. City of Honolulu from the Los Angeles Steamship Docks, Los Angeles, Calif., for the Hawaiian Islands for his annual vacation.

E. A. Andre, formerly manager of exchanges at Fremont, Neb., and Cedar Rapids, Iowa, has been appointed manager of the South Omaha exchange of the Northwestern Bell Telephone Co. He succeeds R. S. Krause, who has been transferred to St. Paul, Minn.

J. S. Cave, of Columbus, Ohio, was recently appointed chief engineer for the Venezuela Telephone & Electrical Appliances Co., at Caracas, Venezuela. Mr. Cave assumed the duties of his new position on November 1 of this year, having arrived in Caracas from London, England, where he had gone to confer with interests identified with the Caracas company.

Mr. Cave's experience has been varied and thorough. It includes ten years of maintenance and engineering work in Dayton, Canton and Youngstown, Ohio; six years of engineering experience in connection with transcontinental telephone lines, and three years in appraisal and general engineering work with the Snook-Hill-house company. For the two years previous to his present connection, Mr. Cave was chief engineer for the Standard Public Service Co. at Columbus, Ohio.

The telephone system of the city of Caracas has recently been converted to Strowger dial operation, and it is expected that the policy of modernization of its equipment entered into by the telephone company there, will be further continued under Mr. Cave's direction.

J. S. Cave, Former Chief Engineer of the Standard Public Service Co., Columbus, Ohio, Is Now Chief Engineer of the Venezuela Telephone & Electrical Appliances Co. at Caracas, Venezuela.

Obituary.

John W. Gilkyson, pioneer official of the Pacific Telephone & Telegraph Co., San Francisco, Calif., and a well known horseman, collapsed and died December 5 after winning first prize in an event at the seventh annual San Francisco Horse Show. He was 55 years old.

Death occurred as Mr. Gilkyson was about to receive a silver cup from the judges. His wife was among the 3,500 spectators as he drove his team of roadsters into the center of the ring and then crumpled forward in the buggy. Physicians attributed death to a cerebral hemorrhage.

Mr. Gilkyson had been with the Pacific Telephone & Telegraph Co. and its predecessor companies 43 years, having started as a lineman and risen through various executive positions until four years ago, when he became special representative out of the general manager's office, reporting solely to General Commercial Manager C. T. Blank.

His first official position with the company was that of division manager at Fresno, Calif., 25 years ago, and from there he went to San Francisco in a similar capacity. After serving several years in San Francisco, he was transferred to Portland with the title of superintendent of traffic, later being sent to Los Angeles as division plant superintendent.

It was about ten years ago that he was again returned to San Francisco, this time with the title of division commercial manager, which position he held until in 1925, when he was elevated to the position of special representative of the general manager, which office he held at his death.

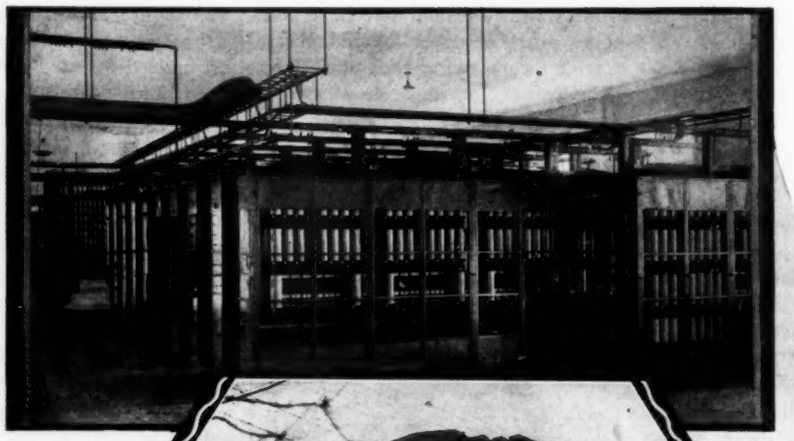
About two years ago he suffered a general breakdown, and because of his illness was compelled to obtain a year's leave of absence. He returned to his duties about a year ago.

Mr. Gilkyson was one of the real pioneers of the telephone business on the Pacific Coast, having been connected with it since the telephone in the West was virtually in its infancy. He was one of the oldest and most honored members of the Telephone Pioneers of America.

Besides his widow, he is survived by a son, Darwin.

Arthur S. Felch, aged 62, right-of-way agent for the Ohio Bell Telephone Co. at Columbus, Ohio, and a veteran in the telephone industry died November 30 at White Cross Hospital, Columbus, after a 10-days' illness from heart trouble. Mr. Felch had been associated with the Ohio Bell Telephone Co. for the past eight years and previously had been connected with the Ohio State Telephone Co. for about 15 years. He leaves two sisters and brother.

Dairen's Varied Popul
Satisfo



Two views of the Strowger Automatic Dial Equipment at Dairen, with the handsome exchange building shown in the center.

STROWGE
DIAL S

When writing to Automatic Electric Inc., please mention TELEPHONY.

...uln Finds Telephone ...sfon in the Strowger Dial

ON the streets of Dairen, Kwantung Peninsula, may be found as strange a mixture of nationalities as exists anywhere in the world. Chinese from every section of that vast country, Japanese, Russians, English and French speaking representatives of many other races; all meet and transact business in spite of their dissimilarity in language and custom.

To meet the difficult problem of providing telephonic facilities for this polygot population, the authorities selected the Strowger Dial as the ideal solution. Since 1923, when the first Strowger Automatic Dial equipment was installed in Dairen, there has been a steady growth in the demand for telephone service; until today there are more than 7500 lines of this equipment in operation in that city. Its highly satisfactory performance has led to its continued selection on the occasion of every addition which has been made to this installation.

Automatic Electric Inc.

Manufacturers of

STROWGER AUTOMATIC DIAL TELEPHONE AND SIGNALING SYSTEMS

Factory and General Offices: 1033 West Van Buren Street, Chicago, U. S. A.

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Twenty Years of Traffic Service Work

Some Important Changes and Continuous Improvements in Handling Traffic in Last 20 Years—Many Changes in Operating Equipment, Including Automatic Ringing—Paper From Up-State Association of New York Convention

By Miss Margaret W. Gonter,
Supervisor of Traffic, Allegany County Telephone Co., Wellsville, N. Y.

My purpose in writing this article is to outline briefly the important changes and the continuous improvements that have marked the handling of the traffic during my period of 20 years of service.

When I started in the service in 1908 there was available little or no effective supervision, either toll or local. There was no such thing as systematic supervision as we now know it, nor was there any such comprehensive aid in handling traffic as the toll operating practice of the present day.

A few months later when I became a toll operator in our Wellsville office, our operating helps were still very limited. We had few printed instructions. Among them was a copy of "Operating Rules" issued in 1906 by the New York and Pennsylvania Telephone & Telegraph Co. This book is made up of 18 pages devoted to toll and local operating instructions, codes and abbreviations.

Early Methods and Phrases.

It is very interesting to note the changes which have been made. These instructions were not filed so we could read them and study them, and we were never instructed as to their use. Of course, the rate and route books furnished us were followed to the best of our knowledge. Our phrases and codes were picked up along the toll lines from operators in other offices.

We did not wish to be back numbers so watched for all new phrasings and made use of them at once. At this time our present offices in the territory were all owned by little separate companies. Our Wellsville switchboard was of Western Electric magneto type, composed of three toll positions and four local, which handled the business very nicely at this time.

In 1910, the Allegany County Telephone Co. took over these local offices and then we were supplied with the New York Telephone Co. traffic department operating rules, composed of general instructions, local and toll, which was a great help. At this time we moved into our present building, and were supplied with a new Western Electric common battery board, composed of three toll and six local positions.

In the year 1918 we took over the Federal exchange. While our own offices had had little or no intensive instructions on the traffic, our competitor the Federal hadn't had any, and it was merely a daily struggle on the part of both companies to complete the calls in any possible way—anything to handle the business.

As organized, our company is composed of a commercial department to run the financial end of the work and provide necessary revenue, and a plant department to build and maintain the necessary central offices, local and long distance circuits for using the telephone.

The 'Oil" of Courtesy.

Last but not least, we have our properly trained operating force to handle the traffic furnished by the public. Now we all know, the traffic department handles all of the calls put in over the telephone; the operating force is human and so is the public. Therefore, the spoken word and its inflections convey whatever impression each gets across to the other. Under such conditions, courtesy, both on the part of the operating force and the public, is like oil to the machinery—necessary to prevent friction.

Realizing the importance of providing facilities, our plant department always cooperates with the traffic employes today to enable us to furnish a better and higher grade of service; in fact, all departments now work in unison for the rendering of satisfactory service to our patrons. We are at our post, desirous of giving the best possible service whenever you call, for service is the one and only thing that the company has to sell to the public.

Necessarily, the responsibility of the traffic is a heavy one. Furnished with an efficient, well-maintained plant, with ample facilities to accommodate the business offered, it is then up to the traffic to handle the calls so as to create with the public a feeling of satisfactory service rendered over our lines and a resolve to use our service even more extensively. When the traffic has done that—it has surely done its full duty. In other words, it has "Delivered the goods."

System in Traffic Handling.

All telephone employes must be kind and courteous. We are servants of the public and should do all in our power to further the interests of our company. When we think of the part each office takes in the work of completing 40,000,000 telephone calls daily we realize what a thorough study has been made of traffic requirements to meet the demand made on our telephone organization throughout the land.

Our aim today is a high standard of service. Cooperation and team work are necessary if we are to be successful. If you will make a careful study of conditions in an unsupervised office and then note the improvement shown under traffic supervision, you can not fail to be most favorably impressed by the advancement shown.

In 1924, we remodeled our board in the Wellsville office and put in combination equipment of two telephone manufacturers which worked out very nicely and effected quite a saving. Now we have come to another up-to-date practice adopted by the New York Telephone Co. and passed on to the connecting companies, that is, the toll centering plan. We are planning now to toll center our territory and expect to have it well under way soon. This will make our whole territory up-to-date in every way with the rules, routine and equipment recommended by the New York Telephone Co.

Equipment Changes.

In 20 years there have been many changes in the operating equipment. I have seen the old magneto switchboards with their hand generator and swinging transmitters give way to our present day-equipment featuring automatic ringing and secret service. I also have seen startling changes in the equipment of operators themselves. The operator of 20 years ago, with her padded pompadour, high top shoes and long skirts measuring 6 to 10 yards around the bottom has vanished completely and today 10 yards would clothe the whole force.

For instance, our skirts measured 36 inches in length and today our dresses measure 36 inches. Of course our personal appearance must be kept up-to-date as well as our equipment.

It is difficult to appreciate all of these changes unless one has grown up with and been a part of them, but these pictures that I have here will give some idea of them and undoubtedly give many of you a good laugh besides.

Prices in the Metal Markets.

New York, December 9.—Copper—Quiet; electrolytic spot and future, 18c. Iron—Steady; No. 2 f.o.b. eastern Pennsylvania, $20@21; Buffalo, $17@18; Alabama, $13@14. Tin—Firm; spot and nearby, $39.75; future, $40.37. Lead—Steady; spot New York, 6.25; East St. Louis, 6.10c.

BIG AND LITTLE, RICH AND POOR, CAN PROJECT THEIR PERSONALITIES OVER THE WIDE NETWORK OF ITS WIRES

In the service of all the people

An Advertisement of the
American Telephone and Telegraph Company

THE Bell System is owned by 450,000 stockholders and operated by more than 400,000 workers for the service of the people of the nation.

It is a democratic instrument of a democracy. Big and little, rich and poor, can project their personalities over the wide network of its wires. For friendship or business, pleasure or profit, the telephone is indispensable to our modern civilization.

This year the Bell System is erecting new telephone buildings in more than 200 cities. It is putting in thousands of miles of cable, thousands of sections of switchboard and hundreds of thousands of new telephones. Its expenditure for plant and improvements in service in 1929 will be more than 550 millions of dollars—half again as much as it cost to build the Panama Canal.

This program is part of the telephone ideal that anyone, anywhere, shall be able to talk quickly and at reasonable cost with anyone, anywhere else. There is no standing still in the Bell System.

Senate Hearings on Communications Bill

Hearings Resumed on Investigation of Radio Phase of Communications—Radio, Wire and Cable Monopoly Advocated by O. D. Young of Radio Corp. of America in Testimony for That Organization—Bell Omitted From Monopoly

The right of broadcasting stations and networks to censor program, or to refuse time on the air to particular groups or factions, was questioned by members of the Senate committee on interstate commerce on December 4, upon resumption of hearings on the Couzens bill to create a federal commission on communications with complete regulatory authority over radio, wire lines and interstate power.

The hearing on December 4 was the first held since June. Members of the Federal Radio Commission and representatives of the radio industry have testified previously.

Creation of a communications commission, with detailed authority over communications, as proposed under the Couzens bill, was endorsed by William D. Terrell, chief of the radio division, Department of Commerce. He said that the regulation now is divided between the Federal Radio Commission and his own agency.

Mr. Terrell said that broadcasting can not be compared with telephone communication. The latter, he said, is individual to individual, whereas by radio "one talks to the entire country."

Radio Censorship.

"In my opinion," said Mr. Terrell, "I believe radio censorship should be left where it is now, with the stations themselves exercising the right to select programs for the listeners. If the situation gets worse later, then you will have to legislate."

A single giant communications monopoly, privately-owned and governmentally regulated, controlling all this country's telegraph systems, cable and international radio facilities, was proposed to the committee on December 9 by Owen D. Young, chairman of the Radio Corp. of America and of the General Electric Co.

In his testimony Mr. Young advocated unification of telegraph, radio, and cable facilities under governmental regulation to meet competition from foreign interests, insisting that unless Congress permitted such consolidations, now prohibited by law, this country would be placed "in a position where others may dictate their use here and we are powerless to protect ourselves."

The question before the Radio corporation, he said, was whether it would be able to hold a "foremost place" in radio communication.

"Whether we look east or west," he said, "we find cables and radio united in all the great nations of the world as a protection to their national interests."

Speaking from a prepared statement, Mr. Young urged that Congress remove the statutory bar to a monopoly of communications and permit the monopoly to be rounded out by inclusion of the Western Union Telegraph Co.

This would be effected by a merger of Western Union with the $400,000,000 International Telephone & Telegraph Corp., which already has "tentatively" agreed to take over the communications business of the Radio corporation.

Monopoly Control Advocated.

He did not specify whether the Western Union should be taken over entirely or only its cable lines. In other parts of his statement, however, he advocated a single great company to control both domestic and international services, with more emphasis on monopoly control in the international field as "a necessity now."

He proposed to omit only the American Telephone & Telegraph Co. Unification of the telephone service with the telegraph services he disapproved "under the present development."

"The communication service is a service to the public," said Mr. Young, "and, therefore, there is no reason in principle why it should not be owned and operated by the government if that be the best way to get the most satisfactory communication service at the lowest cost."

Senator C. C. Dill, of Washington, challenged Mr. Young's statement that virtually all other important countries have communication monopolies.

"Are there any countries where there is monopoly of service and the service is not owned by the government?" he demanded.

"I don't know of any," replied Mr. Young.

"In other words," said Senator Dill, "where they have monopoly, it is a government monopoly?"

"If you mean domestic service, I think that's true," the witness agreed.

Benefits of a Monopoly.

Mr. Young argued that unless international communications were unified, under either private or government ownership, they would be "subject to the dictation and control of foreign companies and government."

"Under the present situation," it would be impossible for this government to regulate rates in the international field, Mr. Young admitted, since there are foreign companies beyond its control. He argued that a monopoly would help this condition, as against a single powerful American company, with government regulation behind it, foreign companies "would not be so arbitrary."

William C. Green, committee special counsel, interposed that the Radio corporation was already bound by contracts with English and virtually all other foreign interests. Mr. Young assented, but declared this "one of the unfortunate results of this competitive situation."

Senator Dill and Senator Burton K. Wheeler of Montana hammered at the Radio corporation's exploitation in advertising of the line: "Founded at the request of the United States government."

Mr. Young testified that when the late Rear Admiral W. H. G. Bullard called on him in 1919 to oppose a sale of Alexanderson alternators by the General Electric Co. to the British Marconi company, he said that President Wilson had sent him. It was after this that the General Electric Co. bought British Marconi's shares in American Marconi and set up the Radio corporation.

Immunity From Laws.

"Claiming immunity from any of the laws, on the ground that President Wilson asked that the company be formed, would be a very cheap thing for the Radio corporation to do," Senator Wheeler remarked.

"I certainly have never claimed any immunity and do not now," Mr. Young retorted with heat. "If any one did, it was entirely unauthorized."

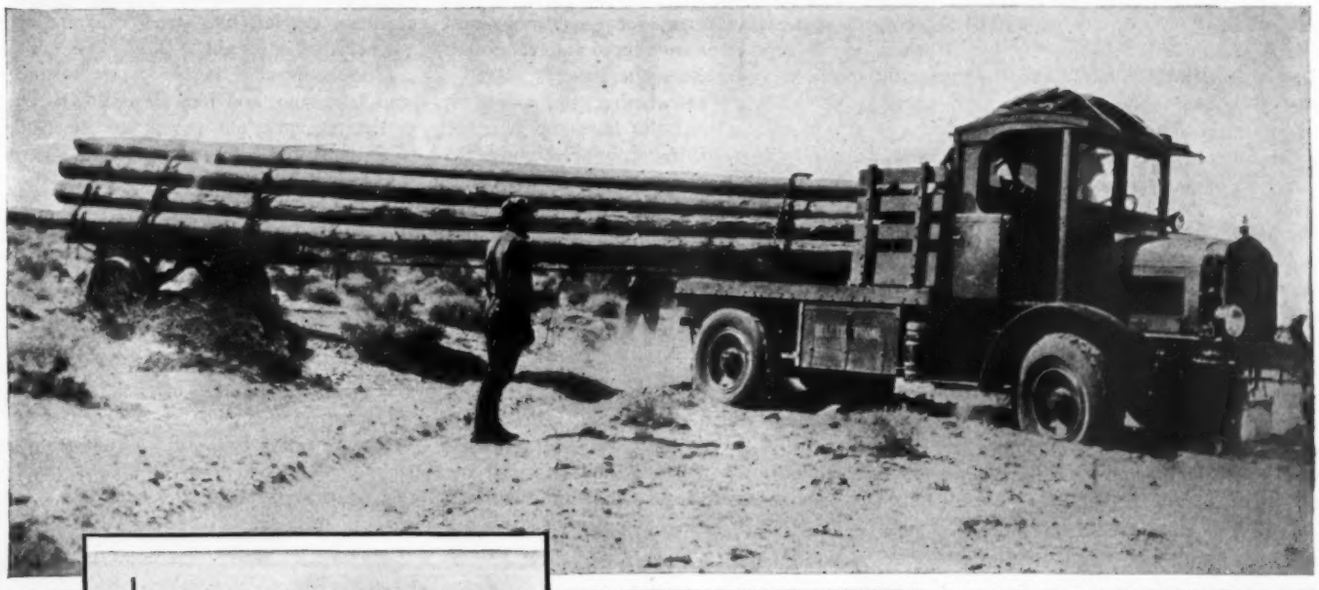
Chairman Couzens declared that nevertheless nearly every Radio corporation witness had used the claim in an attempt to "influence the committee."

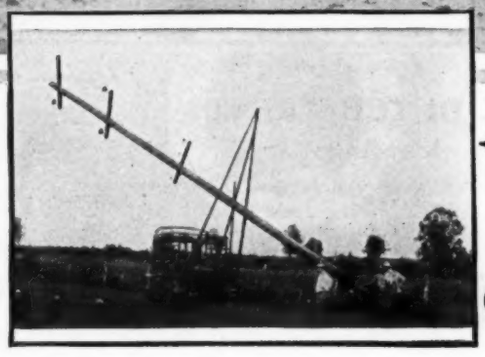
A close relation already existing between the radio and the electric manufacturing industry was disclosed in the questioning of Mr. Young. He listed five General Electric officers or directors and five Westinghouse Electric & Manufacturing Co. officers or directors as members of the Radio corporation's board of nineteen.

The International Telephone & Telegraph Corp. has patent relations with American Telephone & Telegraph Co. and has already taken over the Postal telegraph and cable lines in a merger.

Mr. Young approved communications regulation by a single federal commission, instead of the present divided and largely inactive regulatory control.

Details of the unwritten agreement for transfer of the communication services of the Radio Corp. of America to the International Telephone & Telegraph Co. for $96,000,000 worth of the latter's stock were explained on December 10 by Mr. Young.





Whether it is Hauling or Pole Setting . . . .

FWD *trucks have unparalleled records!*

FWD Utility Trucks are made in 2 to 10 ton sizes . . . four wheel, six wheel trucks, tractor trucks. Send for copy of FWD Utility Truck Bulletin.

HAULING poles over long, rough going or backing into a ditch to set a pole . . . the FWD Utility Truck does both with the same dependability. It boasts of unprecedented performance records in this service.

The FWD Utility Truck is exceptionally powerful and fast . . . and it is surprisingly economical. Because the FWD Truck distributes the power and load to all four wheels it is capable of hauling capacity loads over loose, sandy, muddy soils. Let us send you bulletins describing the FWD Utility Truck in detail. Write today.

THE FOUR WHEEL DRIVE AUTO CO.
CLINTONVILLE, WISCONSIN
Canadian Factory
Kitchner, Ontario

FWD
BACKED BY NATION WIDE SERVICE

When writing to Four Wheel Drive Auto Co., please mention TELEPHONY.

"The preliminary understanding," he said, "called for transfer of 400,000 shares of International Telephone stock to the Radio corporation, half on delivery and the remainder in five annual installments of 40,000 shares each.

Senator Dill (Wash.), long identified with radio legislation, wanted to know how the price was arrived at, and Mr. Young responded: "It was arrived at because I fixed it." He then detailed the reasons by which he arrived at the 400,000 share figure.

Testimony to support the statement by Mr. Young, that President Wilson suggested the formation of the Radio Corp. of America as asserted in some of its publicity, was given on December 10 by Admiral Cary T. Grayson, the former President's physician.

Called at the suggestion of Senator Pittman (Dem., Nev.), Admiral Grayson said that during the Paris peace conference in 1919, President Wilson asked to be reminded that he wanted to send a message to Mr. Young by Admiral Bullard.

As on the preceding day, the testimony aroused some objection from several senators, Senator Hawes (Dem., Mo.) suggesting that if the statement had been made in the corporation's advertising, a sample of the statement ought to be put into the record.

Chairman Couzens ruled the committee was empowered to investigate trade practices and Senator Dill (Dem., Wash.) said the statement "leads the public to think" that President Wilson approved organization of the corporation, whereas he had sought only to protect basic radio patents held in this country.

Scope of Senate Investigation of All Phases of Radio.

A far-reaching inquiry into all phases of radio, involving communications, manufactures, and regulation, and the relationship of wireless communication to the wired modes of conversational contacts, will be conducted by the Senate committee on interstate commerce during its consideration of the Couzens bill (S. 6), and pursuant to the resolution (S. Res. 80), granting the committee authority to make its investigation.

This is shown in a suggested outline of the subjects to be considered, prepared by William C. Green, recently appointed special counsel for the committee, made available on December 7.

In his outline, Mr. Green states the general question of monopoly will be gone into. In the manufacturing field, the document shows, the questions whether a monopoly exists, and if so, whether it is legitimate, will be raised, and asked of witnesses as they are called. "Is monopoly in manufacturing and in communications related?" is another of the questions outlined.

Whether, if it is ascertained that a monopoly in communications by radio does exist, is it necessary for the best interest of the United States, constitutes another trend of the proposed inquiry.

Opinions as to whether the anti-trust provisions of the radio law, and whether the provision of the law prohibiting the joint operation of wireless and wire facilities by the same organizations and individuals, shall be continued in force, also will be sought from witnesses. The question of whether regulatory authority for all modes of communication shall be vested in the proposed communications commission, also is raised.

In the sphere of broadcasting and general radio the committee will elicit opinions as to the propriety of the proposed legislation, and whether the factors of interstate commerce and public utilities shall be considered. Determination of the issue of whether a broadcasting station is a common carrier, like street cars and telephone, also is sought.

The outlines of inquiry as to telephone and telegraph, and into the field of regulation of interstate power and transmission lines, are not specified by Mr. Green. These will be furnished later.

Executive Committee of U. S. Association Plans Future Activities.

The executive committee of the United States Independent Telephone Association held a meeting in Chicago on December 5, at which the annual budget was adopted and plans for the 1930 activities of the association worked out.

On December 6, the committee met with representatives of the Bell in the regular quarterly conference, at which time conditions in the field were discussed.

A DUTCH TREAT

By Miss Anne Barnes,

Traveling Chief Operator, Iowa Independent Telephone Association, Des Moines, Iowa

"The man who can build a better mouse-trap than anyone else has been able to build, will some day find a beaten path to his door."

However, we naturally assume that the successful man will not be in the mouse-trap business when he becomes famous enough to have a beaten path to his door.

The term mouse-trap is used by the author of these lines to typify the most humble work one can be engaged in. He is trying to point out a lesson to those of us who are doing the world's everyday work—the commonplace jobs. A man does not have to change his vocation in order to be rated a success some future day. I know a most successful cafeteria man who got his start in the business as a night clerk 25 years ago. It is not an unusual sight to see a line of folks from the door waiting their turn for service. And they beat this trail daily.

A similar case in a large city came to my attention some time ago.

It was on a wild, stormy night. King Winter had invaded Fall's premises with a terrific slapping snow storm, and Fall thundered an angry remonstrance accompanied by rain, hail and thousands of demoniac wind moanings. But from where I sat in my room, 22 stories up, it mattered not whether Winter or Fall won the battle. I was content to remain just where I was.

Just as I had settled down with a good book for the evening, thankful that I did not have to go out in the storm, two friends called me and asked me to taxi out quite a distance to a renowned little German cafe whose fame for juicy steaks and fine stringed music was favorably known even in New York City, a thousand miles distant. It must be famous, I thought, when the taxi fare alone would probably feed at least two extra people. And such a night! Why, there won't be anyone there. I argued. But they said, "Nothing stops people from going to this place. There's a beaten path to the door."

After holding out for a considerable time, during which my two friends alternated at the telephone, singing the praises of the little German cafe, I finally agreed to go.

We arrived, after being swept through miles and miles of snow, rain, and hail. Would you believe it, the taxi man had a hard time to find a place conveniently near that little German cafe to let us out, as there were so many cars parked along the street. And we were lucky in getting the last vacant table.

Two things were proved to me that night:

I. The author of the mouse-trap quotation was right;

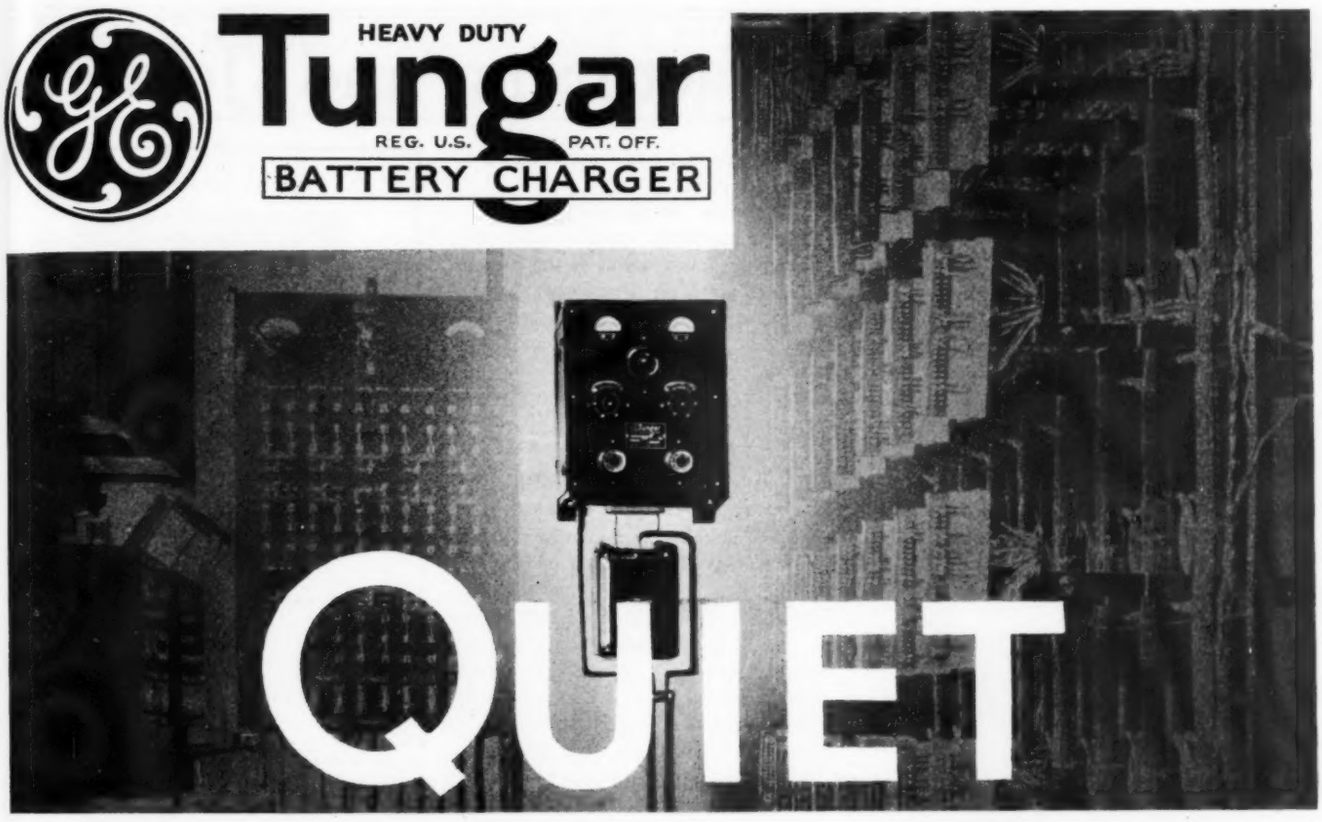
II. One doesn't have to go to New York to win fame.

HEAVY DUTY

Tungar

REG. U.S. PAT. OFF.

BATTERY CHARGER



Quiet on Telephone Circuits

Tungar, world's best known battery charger raises no problem of interference, on intercommunicating systems or small exchanges. Instead it *solves* such problems. Telephone engineers are enthusiastic about its quiet operation.

Find out about Tungar. There's one for every need in telephony. Tungars of the full-wave filtered-output type deliver a floating charge exactly balancing current consumption plus losses.

No standby batteries are necessary. Supervision is at a minimum... power consumption low... tube life long—often more than a year. The charger itself lasts indefinitely and usually without repairs. This means real economy.

General Electric makes half-wave Tungars admirably fitted for installations where there is an "off" period for charging. It can also furnish Copper Oxide Rectifiers to meet special requirements.

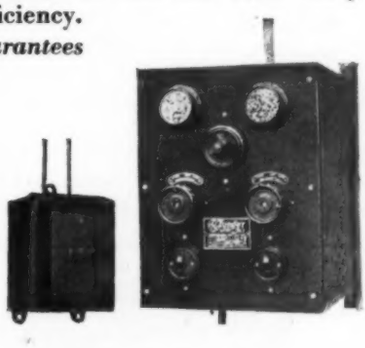
All Tungars are adjustable to suit the load. They work with highest efficiency. *General Electric guarantees them all.*

IT'S FLEXIBLE!

A small Tungar whose charging rate is adjustable—0.3 to 0.5 Amps.

IT'S QUIET!

A 12-ampere size full-wave Tungar with filter reactance.



GENERAL ELECTRIC

MERCHANDISE DEPARTMENT GENERAL ELECTRIC COMPANY BRIDGEPORT, CONNECTICUT

Send this to us today.

**Section T-7112, Merchandise Department,
General Electric Co., Bridgeport, Conn.
Please send me your descriptive booklet "Tungar for Telephone Service."**

Name.....

Address.....

When writing to the General Electric Co., please mention TELEPHONY.

With the Manufacturers and Jobbers

Stromberg-Carlson War Veteran Contender for "Midget" Honors.

When Nicholas Casale, of Newark, N. J., came forth seeking recognition as being the shortest and lightest-weight war veteran in the country, he seemed to cause a turmoil in the army ranks. Among the

Harry Coleman, Shipping Record Clerk for Stromberg-Carlson at Rochester, N. Y., Claims "Midget" Honors in Army.

many who answered the question, "Can you beat that, doughboys?" which appeared with a picture of Mr. Casale, was Harry Coleman, shipping record clerk for the Stromberg-Carlson Telephone Mfg. Co., at Rochester, N. Y.

Mr. Casale secured an affidavit through Representative Fred Hartley stating that he was four feet ten inches tall and weighed 104 pounds when he enlisted in 1918. Mr. Coleman, although he hasn't an affidavit, says the records in Washington will show he was four feet ten inches tall and weighed but 91¾ pounds when he enlisted in 1917. He took part in one major offense, that of Chateau Thierry, and was overseas 11 months. He was honorably discharged in 1919.

Mr. Coleman's small stature doesn't seem to be a handicap, for he can be seen any day moving large radios at the Stromberg-Carlson plant in Rochester, N. Y., where he is employed as a record clerk.

He is shown beside a No. 846 Stromberg-Carlson receiving set, the comparison showing Harry is a good contender for "midget" honors in the army.

Death of John F. Tompkins, Pioneer Independent Salesman.

John F. Tompkins, for many years a well known figure in the Independent telephone field, passed away at the home of his sister. Mrs. Nina T. Graham at Columbus, Ind., on November 2, where he and his wife had been making their home for several months.

Mr. Tompkins was born 70 years ago in Columbus and received his early education there. His first employment was that of clerk in a retail store, after which he worked up to the position of bookkeeper. He was then employed in Peoria, Ill., for four years as a hotel clerk, after which he engaged for four years in the merchant tailoring business.

He began service with Frank B. Cook in 1896 when the latter was interested in the Sterling Electric Co. of Lafayette, Ind. Mr. Tompkins served as purchasing agent for the Sterling company until 1901, at which time Mr. Cook sold his interests in the company and removed to Chicago to manufacture on his own account.

Mr. Tompkins transferred his allegiance to the new establishment in Chicago, becoming general sales manager of the Cook Electric Co. In June, 1918, he left the Cook company and went with Kellogg Switchboard & Supply Co. in Chicago, engaging in special sales work. He remained with the Kellogg company until early in 1925, when he retired from the field.

Mr. Tompkins had many friends all over the country, and was probably one of the best known and most popular man in the Independent telephone sales field.

John F. Tompkins, for Many Years in the Telephone Sales Field, Died at Columbus, Ind., Last Month, at the Age of 70 Years.

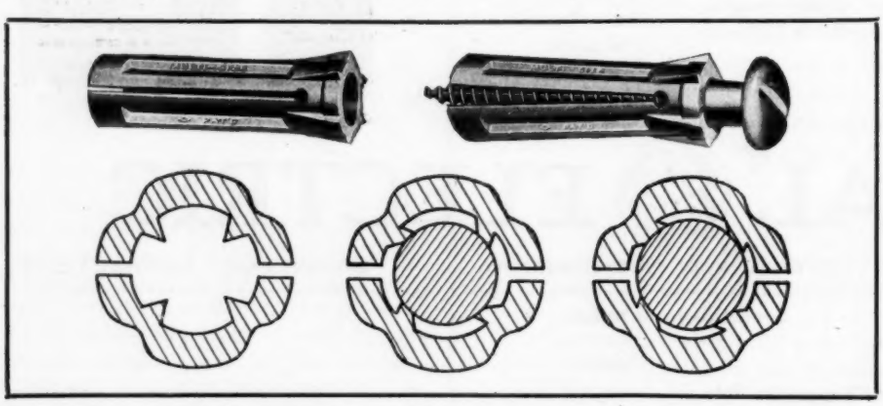
New Multi-Size Screw Anchor for Several Sizes of Screws.

A new multi-size screw anchor, designed to accommodate in one anchor several diameters of wood screws, has just been placed on the market. The purpose of this multi-size screw anchor is to reduce the number of anchors required to accommodate all sizes of screws. They are made in several lengths covering the majority of uses.

In the design of this multi-size screw anchor, ribs on the interior are located over the valleys on the exterior of the anchor. When a small screw is turned into the anchor, it is supported by the ribs. When a larger screw is used, the ribs are pressed down and the valleys at the exterior are forced outward to permit the greater diameter of the screw to enter the shield.

The new improved multi-size screw anchor, which is made by the Diamond Expansion Bolt Co., Garwood, N. J., has two advantages over the original Diamond multi-size anchor. The screw enters the shield more easily without danger of marring the head of the screw and relieves the strain applied to the screw inserted. It will also sustain a greater load.

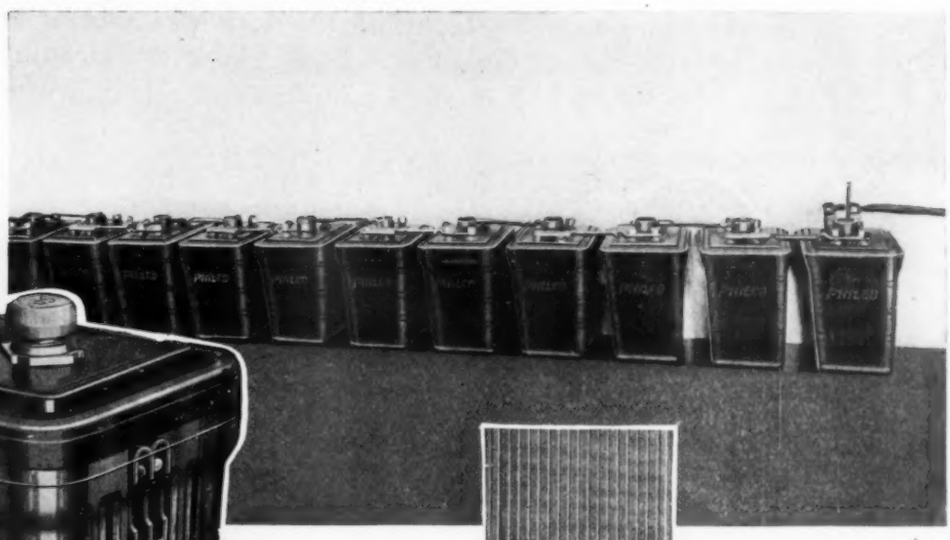
Complete information may be obtained from the Diamond Expansion Bolt Co. at the address given.



The Diamond Multi-Size Screw Anchor With Sectional Views Indicating Its Operation.

ELECTRICAL AND MECHANICAL PERFECTION!

22 V. — 280 A. H. Philco Spray-Proof Telephone Battery in Steel-Glass, Beatrice, Neb., Exchange, Lincoln Tel. & Tel. Co.



√PHILCO RETAINER

WHAT? PRISON WALLS FOR POSITIVE MATERIAL! A durable sheet of hard rubber perforated by thousands of .020 inch slots—Placed on both sides of Philco Processed positive plates.

40% porous—allowing free acid circulation YET holding the positive material firmly in the Diamond Grid thruout the long life of Philco Spray-Proof Power Batteries in Steel Glass.

HOW? The Philco method of *super-bracing* insures the absolute contact of retainer to plate surfaces by the mechanical pressure of CORNER and SIDE LOCKS.

This 100% *retainer effectiveness* is made possible by Philco's advance from the conventional suspended element assembly to the Philco supported and *super-braced* Diamond Grid construction.

WHY? CONSTANT HIGHER CAPACITY THRUOUT A 41% LONGER LIFE!

WATCH THE 11 SUPERIORITY POINTS, M-O-N-T-H - B-Y - M-O-N-T-H

THE 11 POINTS TO PHILCO . . .

1. STEEL-GLASS
2. Corner and Side Locks.
3. Diamond Grids.
4. Philco Processed Plates.
5. √ **Philco Slotted Retainers**
6. Quarter-Sawed Hardwood Separators.
7. Spray-Proof Funnel Vents.
8. Built-in Charge Indicators and Thermometer.
9. Burned-Bolted Connectors.
10. Shipped Fully Charged.
11. Lowest Space Installation and Maintenance Cost.

PHILCO DIAMOND GRID BATTERIES

Philadelphia Storage Battery Company, *Power Division*:
Ontario and C Streets, Philadelphia, Pa.

Please send me Bulletin No. 956 describing in complete detail Philco Spray-Proof Telephone Batteries in Steel-Glass.

Name .....

Street .....

City ..... *State* .....

TUNE IN ON THE "PHILCO HOUR"

When writing to Philadelphia Storage Battery Company, please mention TELEPHONY.

What the Commissions Are Doing

Up-to-the-Minute News Regarding the Activities of State and Interstate Commissions, Courts and City Councils in Matters Concerning Telephone Companies—Summary of Commission Orders and Schedule of Telephone Hearings

Acting to Extend Life of Federal Radio Commission.

Action to extend the life of the Federal Radio Commission has been taken in Congress. Representative White of Lewiston, Me., chairman of the House committee on merchant marine and fisheries, on December 2, introduced a bill (H. R. 5637) to provide for the indefinite continuance of all power vested in the Federal Radio Commission under the radio act of 1927. Senator Dill, of Washington, on December 3, introduced a bill to extend the life of the radio commission.

The Senate interstate commerce committee, to which Senator Dill's bill was referred, unanimously ordered a favorable report to the Senate on December 6. The measure as introduced by Senator Dill was amended to create a chief engineer of the commission at a salary of $10,000 a year.

The committee, meeting in executive session, heard the testimony of Commissioner Charles McK. Saltzman in favor of a chief engineer of the commission, according to an oral statement by Mr. Dill following the session.

Under the Senate measure the commission would be continued only until Congress approves a bill by Chairman Couzens to group radio, telegraph and telephones under the control of a new Federal Communications Commission.

Unless Congress takes action on the radio bill before January 1, the commission becomes a purely judicial body after that date and its administrative duties will revert to the Department of Commerce.

After the meeting of his committee, Senator Couzens said no opposition to the bill was contemplated and that as soon as the House passed a similar measure action would be sought in the Senate.

Illinois Bell Authorized to Reduce Toll Rates Upon Notice.

General reduction of long distance toll rates of the Illinois Bell Telephone Co. on 30 days' notice was approved in an order issued by the Illinois Commerce Commission on December 6. The proposed new schedule of the company will make changes in the present toll rate as follows:

Reduction of 5 to 10 cents, as the case may be, in day station-to-station rates between points 56 to 318 miles distant.

Reduction of 5 cents in a few mileage steps in the present evening station-to-station, person-to-person, appointment and messenger rates.

Reduction in report charges between certain mileage steps, these changes varying from 5 to 15 cents.

On person-to-person, appointment and messenger calls where the initial period rate is over 30 cents or more and the initial period plus the overtime is in excess of ten minutes, the over minutes will be reduced from 5 to 15 cents per minute.

Big Program Outlined in Associated (Calif.) Company Case.

Approximately $10,000,000 worth of extensions and improvements to its various systems during the next five years, and a reduction in telephone rates approximating $40,000 for 1930, were features of the picture drawn for the California Railroad Commission on December 3 by C. F. Mason, vice-president and general manager of the Associated Telephone Co., Ltd. Mr. Mason was before Commissioner L. O. Whitsell as a witness in the commission's investigation into the Associated company's existing rates, which the commission engineers assert are too high.

Expenditures for improvements, extension of its telephone lines and new exchange and office buildings in 1930 will amount to from $1,750,000 to $2,000,000, he testified. A large part of the expansion money will be spent on the Long Beach, San Bernardino and Santa Monica Bay region systems, he said.

The company operates, in addition to these, the telephone systems in Covina and Azusa, Huntington Beach and Westminster, Laguna Beach, Redondo Beach, Manhattan Beach, Hermosa, Palos Verdes and other southern California communities.

Following completion of Mr. Mason's testimony, F. M. Casal, commission telephone expert, was called to testify as to his investigation of the companys' rates and practices, after which Commissioner Whitsell took the case under submission.

At a previous hearing, commission engineers testified that the company earned, for all its various systems, at the rate of 3.57 per cent on its investments in 1928, but that some of its properties earned far in excess of this figure, the figure for the Laguna Beach property being 10.06. The Long Beach and San Bernardino systems earned 10.25 per cent in the same period, the engineers testified.

Expansion plans involving tremendous expenditures are necessitated by the rapid growth of the communities served by the Associated company, Vice-President Mason explained to the commission. Expansion projects include establishment of central exchanges to serve the Las Flores Canyon area, the Malibu country and the Topanga Canyon area. These projects are of a pioneer nature and will be costly, he said.

The rapid growth of Long Beach, he testified, will make the expenditure of large sums of money for extensions of lines and the building of a new downtown central and commercial office building necessary at once.

Establishment of a separate exchange in Westminster and the divorcing of that area from the Huntington Beach district is another projected step, Mr. Mason said. A new central office building in the Santa Monica area also is a necessity, as well as extension of existing lines to care for increased business in the Westwood area.

Proposed reductions in telephone charges by the Associated company in the various districts which it serves include a cut in the charges for moving telephones, extension of the present base-rate areas and reduction of the extra charge for hand telephone sets from 50 cents to 25 cents.

Urbana (Ill.) City Council Imposes City Pole Tax.

To raise funds to finance its fight before the Illinois Commerce Commission for lower rates of the Illinois Bell Telephone Co. at Urbana, the city council of that place has imposed a tax of $2 upon every telephone and electric light pole in the city as well as on awning supports that stand eight feet high.

The telephone rate battle has been in progress for four years. The telephone company estimates that only 350 poles owned by it will be affected but the city expects to derive revenue from between 1,200 and 1,300 poles and supports.

New Schedule of Tolls Authorized for Nebraska Companies.

Authority has been granted the Northwestern Bell Telephone Co. and the Lincoln Telephone & Telegraph Co., to put into effect on January 1 the reduced schedule of toll rates for which approval was asked. As these covered the same subject matter and the changes are the same, the matter was covered in one order of the Nebraska State Railway Commission.

All of these reductions will be effective over the lines of the applicants, and also over the lines of the American Telephone & Telegraph Co. Improved operating methods, vacuum tube repeaters, carrier currents, storm-proof cables and other advances in the art introduced by the Bell system are given credit by the commission as contributing largely toward making these reductions possible.

There being no occasion for a public

SERVICE and SATISFACTION Quick!

Prepare for the New Year

Telephone Accounting Forms

Loose Leaf Sheets and Binders in Stock

Toll Tickets
100,000 lots, 18c per M.

Suttle Equipment Co.
FACTORY AND MAIN OFFICE
Lawrenceville, Illinois

HAZARD
RUBBER INSULATED
WIRE & CABLE

Telephone Wire of Hazard quality

Every type from Drop Wire to Heavy Cable

HAZARD INSULATED WIRE WORKS
DIVISION OF THE OKONITE COMPANY
WORKS: WILKES-BARRÉ, PA.
NEW YORK CHICAGO PHILADELPHIA PITTSBURGH ATLANTA
ST. LOUIS BIRMINGHAM SEATTLE SAN FRANCISCO LOS ANGELES

COOK

SLEEVES FOR WIRE JOINTS

A large percentage of line trouble is due to poor joints.

A good joint should not only test O. K. for conductivity, but have the tensile strength to withstand wind and sleet storms.

One sure way to accomplish this is with the use of Cook Sleeves. Strength and durability are assured. A Cook Sleeve properly twisted 3½ times has a greater strength than the wire itself, and has a perfect conductivity.

A joint made with a Cook Sleeve is a one-time joint. It need never be cut off the line. A saving of time in construction and a reduction of maintenance cost.

Copper or Steel—new or old construction, you will find it economy to use Cook Sleeves.

COOK ELECTRIC CO.

2700 Southport Avenue
Chicago, Illinois

Keeping Faith
with **THE PUBLIC**

MAINTAINING the finest service possible is but the every day duty of a telephone company in carrying out its contract with the public.

"Keeping faith" simply means "use good judgment in the selection of your equipment."

STORM KING batteries have developed a new insulating material, more highly absorbent than any other, which will retain the chemical solution much longer than anything so far developed. The result is the longest service life ever developed in a telephone battery and this in turn means substantial savings to telephone companies in cutting down renewal costs to a new low point.

Manufactured by
GENERAL DRY BATTERIES, INC.
Cleveland, Ohio

Distributors:
A. J. Johnson Elec. Co., Chicago, Ill.
W. S. Nott Company, Minneapolis, Minn.
Suttle Equipment Co., Lawrenceville, Ill.

hearing, the commission entered the order without doing anything other than comparing the proposed rates with the ones now in effect.

Nebraska Commission Denies Application to Cancel Service.

The Nebraska State Railway Commission has denied the application of the Lincoln Telephone & Telegraph Co. for authority to cancel service to five subscribers in the town of Doniphan, where the Hamilton County Farmers' Telephone Association operates an exchange and the Lincoln company does not.

The commission says that having served these persons for 20 years, and they having planned and carried out their business in the belief that it would continue always to be available, they have acquired a right of which they cannot be divested. This right was admitted by the company when it sought to continue a long-standing arrangement by which this service was supplied.

The Lincoln company has been supplying these patrons with lines from its Hansen exchange, through which they were also given free service to Hastings, an important business point. The Hamilton County company serves a large number of subscribers from Doniphan exchange, among them the five persons whose service was in question. The Lincoln company suggested that this gave a duplication of service not in conformity with the best practices of service.

It has no pole line in Doniphan, and for years its lines were placed upon toll poles of the Northwestern Bell. Recently the latter rerouted its lines through the town, and sold the poles to the Hamilton County company. When the Lincoln company sought a continuance of this privilege, the Hamilton County company refused, stating that "better telephone service can be rendered by having but one local service in the community." The Lincoln company is now faced with the necessity of building its own pole line or melting the hard heart of the Hamilton County company.

The protestants insist that there was no duplication of service, as that which is purchased from the Lincoln company is entirely different from that supplied by the Hamilton County company. They insisted that the service to Hastings was of great importance to them because of business relations built up over a period of years, and that as the Bell would route toll calls through Grand Island, necessarily the service would be slow and unsatisfactory. This service has been open to all residents of Doniphan for years, and the only trouble experienced has been to prevent its use by persons not paying for it.

The commission finds that the number of users over a period of many years having always been small, the future demand will not be such as to embarrass the applicant company's lack of necessary facilities, and will not reach such proportions as to make real competition locally between the two companies. The applicant apparently recognized a right of these subscribers to a continuation of a service which they had enjoyed for 20 years, when it made a request of the Hamilton County company for the use of its poles in Doniphan, whereby such service might be continued.

The conditions that confront the applicant, says the commission, as a result of this denial does not seem to justify the granting of the request. The placing of a few poles will be necessary. The securing of a franchise under the existing circumstances will probably not be difficult. The Hamilton County company can obviate this necessary procedure on the part of the applicant and avoid the granting of a franchise to a competing company, by permitting the Lincoln company, for a reasonable charge, to use the few poles necessary in the town.

The competition complained of by the Hamilton County company, the commission states, is not a new thing. Neither is it of such proportions as to occasion any alarm, especially having in mind the fact that each of the Lincoln company subscribers also buys Hamilton County company service.

Bell Asks Permission to Purchase Interest In Line.

A joint application was filed recently with the Missouri Public Service Commission by the Ozark Central Telephone Co. with headquarters at Cabool, and the Southwestern Bell Telephone Co. for authorization of the sale of a three-fourths interest in the Ozark Central company's telephone line from Cabool north about 140 miles to the Southwestern Bell company lines about 10 miles east of Jefferson City. The purchase price is to be $92,134, it is stated.

The Southwestern Bell company is buying a three-fourths interest in the Ozark Central toll line and the right-of-way and an entire interest in one circuit. The Ozark Central company retains the other one-fourth interest for its own business. The arrangement will eliminate the necessity of the Southwestern Bell company constructing a new toll line along the route.

Rate Increases for Two Missouri Companies Allowed.

The Missouri Public Service Commission recently issued an order granting an increase in the rates to the Mid-West Telephone Co. in the town of Sarcoxie, Jasper county. The increase granted is 50 cents per month on business telephones, with $1 per month for extensions and 50 cents per month on multi-party residence telephones.

In another order the Southwestern Bell Telephone Co. was granted an increase for its local exchange at Bowling Green,

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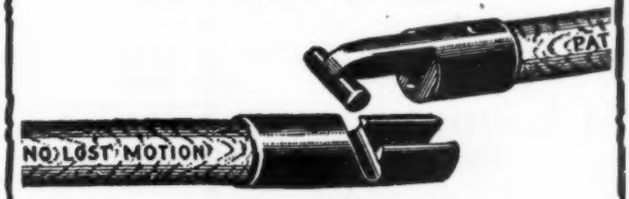

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Pike county. This increases single-party business lines from the present rate of $2.50 per month to $3.50 and business extensions from 75 cents to $1 per month. Single-line residence rates increased to $1.75 per month and two-party residence lines from $1.50 to $1.75 per month, leaving residence extensions at 50 cents per month instead of 75 as asked by the company.

To Reduce Long Distance Telephone Rates in Missouri.

A fourth voluntary reduction in long-distance telephone rates in Missouri during the last three years will be effected January 1 under schedules filed recently with the Missouri Public Service Commission by the Southwestern Bell Telephone Co. The rate reduction may save Missouri telephone subscribers about $212,000 a year, according to estimates.

The reduction will apply principally to day "station-to-station" rates to points 60 to 300 miles distant. In a majority of the revised schedules the rate cut will amount to 10 cents, while in others it will be only 5 cents.

Rates on person-to-person calls and those made at evening and night will remain virtually as at present.

Increased Rates Upon Completion of Common Battery Service.

The Southwestern Bell Telephone Co. was recently authorized by the Missouri Public Service Commission to place in effect the following schedule of monthly rates at its Norborne exchange, after the work of changing the plant to metallic common battery service has been completed:

Business, one-party	$3.50
Residence, one-party	2.25
Residence, four-party	1.75

The company introduced testimony to the effect that there would be expended for materials and labor in doing the work necessary to provide common battery metallic service approximately $25,891; of the plant now in use there would remain in service property of the value of $4,208, making a total of $30,099 as a reproduction cost new of the property after the completion of the work.

After reducing the value of the property remaining in service to $2,941, because of depreciation, the reproduction cost new, less depreciation, would be $28,832, the commission said. To the latter figure should be added $669 for general equipment, $559 for working capital, and $3,086 for going value, making a total value of $33,146 after the work of converting the plant to a common battery metallic line system had been completed.

A statement filed by the company showed that the total revenue received for service at the Norborne exchange during 1928 was $7,670.05, and that the operating expense had been $9,237.74. The expense account contained an item of $1,660.73 for depreciation of plant and equipment, thus showing a loss for the year of $1,567.69.

The additional revenue from the proposed rates was estimated at $2,346 and the additional savings in expense at $773, making a total of $3,119 additional revenue that would be provided after the conversion of the plant. After deducting the net loss based upon the year 1928, there would be under the proposed rates $1,451 for return on the investment of $33,146, or 4.38 per cent, the commission said.

The commission made no inventory and appraisal of the property, but, in view of the fact that the proposed rates had practically been agreed upon between the city officials and the company, concluded to permit increased rates to become effective.

Wisconsin Company Allowed Increased Switching Service Rates.

On November 30, the Wisconsin Railroad Commission rendered its decision in the matter of the application of the Odgensburg Telephone Co. of Ogdensburg for authority to increase its rates. The company was authorized to discontinue its present rate of $5.00 for switching service and to substitute therefore a rate of $10.00 per switched telephone per year.

The commission found that during the years 1926 and 1927 the company received a fair earning on the book value of the property, but that during 1928, due mainly to an increase in operators' wages, the company operated at a deficit.

Summary of Commission Rulings and Schedule of Hearings.

INTERSTATE COMMERCE COMMISSION.

November 21: Southern Bell Telephone & Telegraph Co. authorized to acquire the properties of B. F. Hatch, doing business as the Uniontown Telephone Co., Uniontown, Ala., which serves 173 subscriber stations.

ALABAMA.

November 22: Purchase approved by the South States Utilities Co. of telephone properties formerly owned by South Central Telephone Co. in the following towns: Phil Campbell, Dime, Bear Creek, Haleyville, Ash Ridge, Double Springs, Hackleburg, Hamilton, Guin, Vernon, Aliceville, Carrollton, Gordo and Reform.

CALIFORNIA.

December 2: The Pacific Telephone & Telegraph Co. applied for authority to acquire the Merquin Telephone & Electric Light Co., operating in the Stevinson Colony, Merced county, for the sum of $3,000.

December 3: Hearing on commission investigation of rates of Associated Telephone Co., Ltd., of Long Beach. Testimony for company given by Vice-President and General Manager C. F. Mason, and case taken under advisement by Commissioner L. O. Whitsell.

December 4: Commission denied a petition for a rehearing of the application of Pacific Telephone & Telegraph Co. for an increase of rates and to readjust its exchange areas in San Francisco and the

East Bay territory. Petition was filed by California Northern Hotel Association.

ILLINOIS.

November 14: Agreement approved whereby Tri-County Mutual Telephone Co. leases all of its property to E. T. Sallee for a period of 10 years at annual rental of $320 and a further sum of $376 to create a fund for purchase of materials, etc., together with option to purchase all of property within a period of five years.

November 21: Order approved cancelling and annulling schedule of Hoopeston Telephone Co. containing rules, regulations and conditions of service in Hoopeston and vicinity and authorizing the company to file a revised schedule of rules relating to payments for service.

November 21: Order approved authorizing Illinois Valley Telephone Co. to increase exchange rates at Camp Point when town lines are made metallic. The following schedule will be placed in effect: Individual business, $3.00; individual residence, $2.00; two-party business, $2.50; four-party residence, $1.50; rural multi-party business, $2.50; rural multi-party residence $1.50.

November 21: Order approved authorizing Dixon Home Telephone Co. to discontinue free service to Amboy, Ashton, Compton, Franklin Grove, Lee Center, Paw Paw, Subletter, Walton and West Brooklyn, and to put in effect toll rate schedule in lieu thereof; also approving a traffic agreement between Dixon Home Telephone Co. and Farmers Telephone Co. of Lee county.

November 21: Order approved authorizing Deer Creek Telephone Co. to place in effect toll rates from Deer Creek to Washington, Mackinaw, Morton and Carlock, effective as of December 1, 1929.

November 21: Complaint dismissed of M. G. Livingston regarding failure of Illinois Bell Telephone Co. to furnish facilities at his premises at Lawrence and Harlem avenue in Norwood, Cook county.

November 21: Order approved suspending until March 30, 1930, proposed rates for rural telephone service in Tri-City, stated in rate schedule of Southwestern Bell Telephone Co.

November 21: Order approved permitting Illinois Bell Telephone Co. to charge monthly rate of $1 for furnishing busy test cabinets.

November 21: No action taken on schedule of standard toll rates effective January 1, 1930, of Home Telephone Co. of Arenzville.

November 26: Order approved dismissing complaint regarding collecting in ad-

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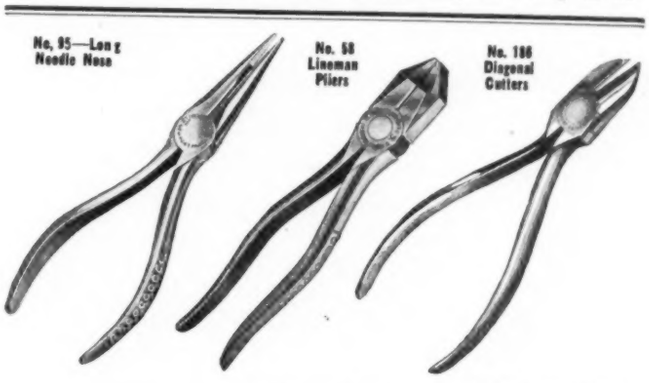

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vance, discontinuance of service and charge for reestablishing service in case of failure to comply with collection rules of company, and directing DeKalb-Ogle Telephone Co. to make proper reparation to complainant for money collected for periods during which complainant's service was suspended.

November 21: Order approved suspending until April 5, 1930, proposed rates for telephone service in Shumway and vicinity, stated in schedule Ill. C. C. No. 1 of Shumway Mutual Telephone Co.

November 26: Order approved suspending until April 19, 1930, proposed rates for telephone service in Belleville and vicinity, stated in second revised sheet 1A and original sheet 1B to Ill. C. C. 1, of Southwestern Bell Telephone Co.

November 26: Order approved authorizing Bond County Telephone & Telegraph Co. to issue and sell $27,000 aggregate par amount of its common stock, consisting of 900 shares of the par value of $30 per share.

November 26: No action taken on:

Standard Telephone Co. schedule Ill. C. C. No. 1. Original sheet 4 covering hand telephone sets in place of wall sets, with extra monthly charge of 25 cents applying to various exchanges of the company. Effective November 30, 1929.

Corn Belt Telephone Co. supplement No. 1 to Ill. C. C. 1, covering hand telephone sets in place of wall sets, with extra monthly charge of 25 cents applying to various exchanges of the company, effective November 30, 1929.

December 6: Order issued approving general reduction of long distance toll rates of the Illinois Bell Telephone Co. on 30 days' notice.

December 10: Hearing at Chicago in the matter of the proposed advance in rates for service of the Illinois Bell Telephone Co. in Edwardsville, Madison county, stated in rate schedule Ill. C. C. No. 3 filed by the company.

December 10: Hearing at Chicago before Commissioner Gilbert in the matter of the proposed advance in rates for service of the Illinois Bell Telephone Co. in Decatur, stated in rate schedule Ill. C. C. No. 2 filed by the company.

December 11: Hearing at Chicago before Commissioner Kuhn in the matter of the complaint of the city of Marengo vs. the McHenry County Telephone Co. relative to service in the city of Marengo.

December 11: Hearing at Chicago before Chairman Hadley in the matter of the proposed advance in rates for service of the Illinois Northern Telephone Co. in Macomb, McDonough county, stated in rate schedule Ill. C. C. No. 2 filed by the company.

December 12: Hearing at Chicago before Commissioner Wilson in the matter of the joint application for consent and approval of contract of purchase and sale of the entire properties and franchises of the Polo Telephone Co. to the Northwest Telephone Co. of Freeport, and sale by the Polo Telephone Co.; also for a certificate of convenience and necessity to the Northwest Telephone Co. to operate the properties and to issue 800 shares of its 6 per cent capital stock and 4,800 shares of its common capital stock.

MINNESOTA.

December 4: Minnesota Communities Telephone Co. authorized to purchase the Cannon Valley Telephone Co., Waterville; Farmers & Merchants Telephone Co., Arlington, Henderson Telephone Co., Henderson; Scott County Telephone Co., Jordan, and Citizens Home Telephone Co., Belle Plaine.

December 16: Hearing at St. Paul in

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the matter of the application of the Tri-State Telephone & Telegraph Co. to purchase a majority of the capital stock of the Nicollet County Telephone & Telegraph Co., Nicollet.

December 16: Hearing at St. Paul in the matter of the application of the Tri-State Telephone & Telegraph Co. to purchase a majority of the capital stock of the Redwood Falls Electric Telephone Co., Redwood Falls.

December 18: Hearing at Webster in the matter of the application of the Tri-State Telephone & Telegraph Co. and Webster Farmers Telephone Co. to discontinue the furnishing of free service between subscribers of the Northfield exchange of the Tri-State company and subscribers of the Webster Farmers Telephone Co. at Webster, Lonsdale and New Market exchanges.

December 19: Hearing in the matter of the application of the Central West Public Service Co. for authority to change its schedule of telephone rates at its Lakeville, Prior Lake and Rosemount exchanges.

MISSOURI.

November 30: Joint application filed by Ozark Central Telephone Co. and the Southwestern Bell Telephone Co., the former to sell and the latter to buy a toll line 140 miles in length, extending from Cabool, Texas county, through the counties of Pulaski, Phelphs, Maries and Osage to an intersection with the Bell lines on Highway No. 50, ten miles east of Jefferson City.

The Southwestern Bell company proposes to buy a three-fourths interest in the line for $92,134.

December 3: Midwest Telephone Co. authorized to file its schedule of rates at Sarcoxie as asked for in its application, effective January 1, 1930.

December 5: Southwestern Bell Telephone Co. authorized to file its schedule of rates to be charged at Bowling Green as asked for in its application filed on September 17 with the exception that the rate for residence extension be 50 cents per month instead of 75 cents per month as asked; rates to become effective on first day of calendar month after the work of installing a common battery metallic line system at Bowling Green has been completed.

NORTH DAKOTA.

November 4: Joint application granted of Home Telephone Exchange of Sykeston and William Clifford, Mohall, to sell and buy, respectively, the telephone property in Sykeston.

November 4: Revised exchange tariff for Wilton filed by the Northwestern Bell Telephone Co., approved.

November 4: Revised exchange tariff filed by Northwestern Bell Telephone Co. applicable at Kenmare, approved.

November 27: Joint application filed by Parshall Farmers Telephone Co. and Mountrail Telephone Co. to sell and buy, respectively, the telephone line running south from Wabek to Plaza exchange.

November 27: Wildrose Telephone Co., Wildrose, filed application for authority to dismantle certain pole and wire line near Wildrose.

OKLAHOMA.

December 10: Hearing on application filed by Pocasset Telephone Co. Pocasset, for increased rates.

December 10: Hearing on application filed by Southwestern States Telephone Co. for increased rates at Asher.

WISCONSIN.

November 30: Ogdensburg Telephone Co., Ogdensburg, authorized to increase its rates for switching service from $5.00 to $10.00 per year.

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POSITION WANTED — Competent, reliable telephone man desires permanent position. References. Reasonable salary. Not now employed. Address 7628, care of TELEPHONY.

WANTED POSITION — Telephone man who knows his work and is not afraid to do it, wants position. Can best qualify as wire chief, trouble-man, installer, line man, or any combination of these. Years of experience on magneto and common battery, local and toll, outside and inside. Some automatic experience. References furnished or will come on trial. Go anywhere—reasonable salary. Address 7621, care of TELEPHONY.

WANTED—Situation as Accountant by experienced woman. Formerly Accountant, Auditor and Assistant Manager for 14 years, of company with 6,000 stations. Excellent references. Address 7627, care of TELEPHONY.

POSITION WANTED—After Jan. 1st —as public relations man—fifteen years' experience dealing with the public and with regulatory commissions. Best of references. Address 7623, care of TELEPHONY.

NEW
GREEN CORDS

2 conductor stand cords	$ .25
3 conductor stand cords	.35
4 conductor stand cords	.45
5 conductor stand cords	.55
Kellogg No. 26-D operator's cord	.35
Kellogg No. 67-D operator's cord	.55
Kellogg No. 239 operator's cord	.55
New Western Electric Co. green, red or white 2 conductor switchboard cords for S.C. No. 57 plug, 72-inch	.35

Buckeye Telephone & Supply Company

1432 S. Parsons Ave. COLUMBUS, O.

FOR SALE

W. E. 24-VOLT switchboard lamps @ $10.00 per 100. Bakelite mouth-pieces for W. E. Transmitters @ $6.00 per 100. Armatures for W. E. No. 22 generators @ 75c, for W. E. No. 47 generators @ $1.00, for W. E. No. 48 generators @ $1.25. Monarch Ring, Listen and Ring-back Keys @ $1.00. No. 17 parallel bronze drop wire @ $6.50 per 1000 feet. **The TELEPHONE REPAIR SHOP** 6966 Ravenswood Ave., Chicago.

FOR SALE—Cook No. Ten Arrestors, perfect condition, complete with heat coils and carbons, 20 pr. banks, $3.50 each. Sample for approval. WHITTIER HOME TEL. & TEL. CO., Whittier, California.

FOR SALE—4 positions Western Electric Co.—1248 Common Battery Lamp Switchboards, equipped for 740 lines. One of these positions equipped with 15 pr. Universal Toll and Local Cord Circuits.

1 Mercury Arc Rectifier, 10 Amp. capacity.

1 Gasoline-Generator Set—24-36 volt—20 Amp.

75 No. 294 Western Electric Co. Sub-Sets, less receivers.

To move quickly this equipment can be bought cheap.

PETERSBURG TELEPHONE CO., PETERSBURG, VA.

FOR SALE—Telephone plant 400 stations. Income $8000. 7-room modern house included, $35,000 if taken soon. $20,000 will handle. Address 7635, care of TELEPHONY.

FOR SALE—W. E. Desk Bells, 2 and 3 box, 1000 and 2500 ohm, straight and biased ringers. Taken out account change to common battery. Address 7632, care of TELEPHONY.

FOR SALE—Several small exchanges. Bargains. E. W. Rollins, Hall Street, Spartanburg, S. C.

WANTED TO BUY

WANTED TO BUY—Magneto telephone exchange of 500 telephones; Iowa, Nebraska or South Dakota preferred. Address 7631, care of TELEPHONY.

POSITIONS WANTED

POSITION WANTED—As combination manager and troubleman of small exchange. Wide experience with both Bell and Independent companies. Best of reference. Details, first letter. Address John Culbertson, Shannon City, Iowa.